VISION ASSESSMENT AND PROGRAM MANUAL FOR SEVERELY HANDICAPPED AND/OR DEAF-BLIND STUDENTS

Developed by the staff of the
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INTRODUCTION

This vision assessment manual is intended for use by teachers of deaf/blind students, teachers of severely handicapped students, and resource or itinerant teachers in the area of vision who have recently begun serving low-functioning students. The manual is not intended to be a substitute for a thorough ophthalmological examination, but is instead intended to serve three functions.

The first function is to prepare teachers for participation in interdisciplinary or transdisciplinary teams. To communicate with medical professionals, educators must have a basic understanding of the sense of vision and be able to use and understand terminology used in reference to structure and function of the eye. Information on structure and function of the eye comprises the initial section of this manual.

The second function is provision of visual efficiency assessment procedures. The second part of the manual consists of various assessment procedures. Sections I-III provide assessment procedures and supporting information for those visual behaviors which are reflexive or are generally considered to form the physiological basis for a student's visual functioning (blink reflex, ocular coordination, peripheral visual fields, etc.). Section IV reviews available procedures for evaluation of tracking and shift of gaze, and Section V is an assessment of visual acuity. The information is then summarized and shared with the student's eye specialist. The eye specialist can interpret the data that are gathered and provide consultation to the teacher as to appropriate instructional goals for the student.

The third function of the manual is to provide guidelines for instructional procedures used to establish functional vision use in the classroom.

Before using this manual, a number of cautions should be noted. This manual is intended for use by teachers who demonstrate the following competencies:

1) Proficiency in task analysis as an instructional strategy for severely, multiply handicapped students.
2) The ability to measure student progress toward instructional objectives by gathering daily performance data and evaluating student performance based on these data (c.f. Haring, Liberty, and White, 1980).
3) Understanding of basic principles of behavior analysis, including principles of operant conditioning (c.f. Kazdin, 1975).

Users who lack these competencies may experience difficulty in application of manual assessments and programs.

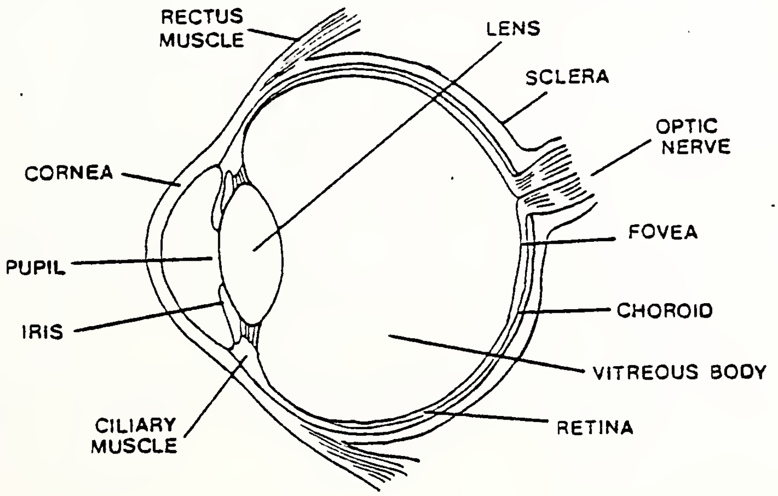
STRUCTURE AND FUNCTION OF THE EYE

by Jan Peterson

The eyes provide the greatest majority of sensory information to the brain in normal individuals of any age. The human ability to perceive, learn from and modify the environment, is thus greatly influenced by normal vision or the lack of it.

Visual Process and Anatomy

The eyes themselves normally function as a coordinate pair of complex sensory organs located in a pair of bony orbits which face forward in the skull. Each eye is a basically spherical body with a tough outer membrane, the sclera, covering all but the bulge of clear cornea in the front. Just inside the sclera is the choroid, a deeply pigmented layer which carries the main blood supply for the eye. Lying against the choroid is the retina. The retina contains the light sensitive rods and cones and the complex layer of nerve cells and connections which converge and exit as the optic nerve.



As light enters the eye through the clear cornea, it is bent (refracted) and passes through the pupil. The iris, by muscular contraction, can change the size of the pupil and control the amount of light entering deeper parts of the eye. The light next encounters the lens, which can again refract the light in varying amounts with the action of the ciliary muscles to provide focusing of the light. Passing next through the gel-like vitreous humor, the light finally arrives at the network of ganglion and biopolar cells. It passes through this network to reach the photosensitive pigments of the retina.

Certain of the regions of the retina are far more sensitive than others. The region corresponding to central vision where acuity is best is called the fovea. The fovea is a relatively small portion of the retina and has a very dense cone photoreceptor cell population. The remainder of the retina corresponds to the peripheral field of view. The peripheral vision fields are important for helping the eyes be coordinated, and for detecting objects or movements that can then be regarded with central vision.

In order to fixate or track an object of regard, the eyes each use a set of six muscles that control the movement and direction of the eyeball. They are innervated by three cranial nerves and are under both partial voluntary and involuntary (reflexive) control. Development of the coordinated work of these muscles, in conjunction with the intraocular muscles (for pupil construction/dilation and lens focusing) is important to the development of fine visual motor skills. For example, picking up a small object requires convergence, proper focusing, and coordination of visual information in the brain in order to make an accurate motor response.

Development

At birth, while visual acuity may not be impressive in terms of what an adult can see, an infant does see and can soon discriminate a variety of objects and patterns. Initially, only the unconditioned compensatory fixation reflex is present. The fixation reflex allows the eyes to remain directed at an object when the head is turned. A series of reflex patterns soon develop which enable conjugate eye movements (tracking), refixation, and pupillary responses to occur. Later, accomodation (a change in thickness and curvature of the lens to adjust the eye for near vision - accomplished by action of the ciliary muscles) and fusional movements (movements of the eyes which bring the images of regard onto corresponding points of the retina) are developed to provide complete coordination of the eyes.

The gross milestones of the developmental sequence of vision are briefly outlined in Table I, with the reminder that these exist on a continuum which permits overlap and blending.

Age	Reflexes Appearing	Perception/Cognition Noted
At birth to first few days	Sustain fixation on stationary object Conjugate eye movements to sounds Compensatory eye movements in response to turned head Optokinetic nystagmus present Pupil consensual response present	Low/modest acuity (at least 20/400, possibly 20/200 or better) Pattern discrimination and preference (high contrast preferred; schematic drawing of face preferred to photograph)
2-5 weeks	Pursue moving target with eyes	Discrimination between striped and bull's eye patterns observed Discrimination between straight and curved line segments observed
7-8 weeks	Ocular accommodation and convergence begin to appear	Beginning spatial perceptions, including depth perception, size and shape constancy. 3-D clay face preferred to 2-D figure
2-4 months	Convergence well established	Increased fixation to "proper" vs. "scrambled" drawings of face Peak of interest in patterns and pattern variations
6 months	Ocular-motor development nearing completion Stereopsis and corrective fusion reflex established	Increased visual exploration in conjunction with manual and locomotor exploration Decreasing interest in non-tactile, flat patterns Acuity gradually increasing to at least 20/200, possibly much better
1 year		Approximately 70% of best acuity developed Change in selective attention: solid objects, moving targets preferred
2+ years		Best acuity fully developed

Table 1: Visual Development

GENERAL ASSESSMENT CONSIDERATIONS

This assessment evaluates four aspects of visual behavior: 1) gross measures of vision; 2) ocular coordination; 3) peripheral fields; 4) far point visual acuity. The format of the manual is as follows: Each aspect of visual behavior constitutes a separate section! Within each section, two pages are devoted to each measure of visual behavior. The page on the left consists of descriptive or background information for a particular aspect of visual behavior. The page on the right contains the procedures for assessing that visual behavior. The teacher should read the descriptive information and study the assessment procedures together. No results are to be recorded within the text of the manual. There are separate blank recording forms at the end of the manual to be reproduced for each student assessed.

This assessment is <u>not</u> intended as a test to be completed in one session. Rather, each section of the assessment may be administered separately, or several assessments may be administered in one session if the student is cooperative. In addition, not all students may need <u>every</u> assessment. If, for example, a student has had an opthalmologist exam indicating he does have vision, and you are concerned with obtaining an acuity measure, you may procede directly to Section 4. However, if a student has not had a formal vision evaluation and/or you are uncertain about his/her visual functioning, each section of the assessment should be completed.

Several general rules should be followed during administration of any one of the assessments. They are:

<u>Student factors</u>: The first student factor to consider is <u>positioning</u>. For ambulatory students, the student may be seated in a chair or comfortably on the floor. The teacher should position himself/herself so his/her head is on the same plane as the student's head. The teacher should be close enough (18-24") and at eye level with the student to observe the student's response.

The visual behavior of many severely physically involved students is affected by the presence of abnormal reflex activity and excessive extensor tone. For students with severe physical disabilities, the teacher should consult with a physical or occupational therapist. Discuss with the therapist the kinds of responses you will be looking for and determine a position which facilitates normal muscle tone but which will still allow accurate observation of the student's eyes. Use this position to replace the sitting position described in each section.

An additional factor which may influence assessment results is medication. Record the name and dosage of each student's medications at the top of the form found in Appendix A - Summary form for Opthalmologist. A list of their effects on vision is found in Appendix B.

The final factor to consider during administration of the vision assessment is the student's level of alertness. This quality of a student's responsivity is referred to by infant educators as state (Moss and Robson, 1970; Wolff, 1973). Some severely handicapped individuals are lethargic due to medication or other factors not easily identifiable. Other severely handicapped individuals are extremely active and distracted by either self-stimulatory behavior or people, materials, etc. outside of the immediate environment. For both groups of students the teacher should work toward assessing the student when he/she is alert and quiet.

The position of physically involved students may affect their state. Fieber (1974, 1978) has been successful in producing alerting and eye-opening in lethargic, severely handicapped individuals by bringing a student abruptly from supine to upright and/or gentle bouncing. This would be appropriate for students with low tone. For those physically involved students with fluctuating or excessive tone, a relaxation technique such as slow rocking is useful for normalizing tone prior to and during assessment.

Disruptive behaviors such as "out of seat" behavior and high rate self-stimulatory behavior may interfere with assessment results. For those disruptive students the teacher should establish stimulus control over disruptive behavior prior to assessment. The reader who is unfamiliar with behavior management techniques is referred to Kaufman and Snell, (1977) and Kazdin (1975) for more information.

Setting factors: In general, all of the assessments can be performed in the context of the classroom. Where particular lighting factors are required, they are indicated in the individual assessment procedures.

Procedural factors: It is recommended that you conduct assessment items in short sessions lasting from 5-10 minutes each.

The teacher should study the procedures thoroughly prior to administration of the assessment with a severely handicapped student. It is recommended that the teacher practice each procedure on another "normal" adult until the teacher can perform the procedures smoothly and quickly. The teacher must know what he/she is looking for before implementing each of the procedures.

In addition, when you are actually performing the assessment with a student, it is suggested that you try the procedure 1-2 times on a preliminary basis with the student, so you will have a sense of how that particular student responds. Do not score these preliminary two trials. Administer additional trials which you score as specified in the procedures once you have a sense of the student's visual response.

The assessment items should be presented as discrete trials. It is appropriate to structure each assessment session with spoken and/or signed cues such as "(student's name), look", or "(student's name), touch the ball". Structuring the assessment sessions will help the teacher organize the school day and present clear discriminative stimuli to the student.

Reinforcement in the form of verbal praise, touching, or stroking, etc. should be delivered throughout the assessment, both for appropriate visual responses and for in-seat and attending behaviors. Because only a limited number of trials are presented for each behavior, the student will not have adequate opportunity to learn visual behaviors merely by participating in the assessment.

Scoring of all responses is done by using a plus (+) to indicate a clearly observed response and a minus (-) to indicate a clearly observed lack of the response. You are encouraged to omit from scoring trials in which you assess your timing or presentation of the test stimuli to be inappropriate. If you are not confident that you have observed a clear response or clear lack of response, discount the trial and re-present it.

Materials: A number of differing visual stimuli and materials are required for each test. All of the items needed to perform the complete assessment are listed on the following page, along with where specific items can be purchased.

MATERIALS

Item	Recommended Type	Source
Penlights (2)	Ones with silent switches. May be inserted into large plastic pop bead or finger puppets to enhance attention.	Nursing supply store Stationary store
Clip on light with bare bulb (60w)	Large flashlight with 5" beam or lamp with removable shade may also be used.	Hardware store Stationary store
Occluder	A 5 x 7" blank card may also be used. These materials are used to block vision in one eye while observing responses in the other eye.	Bernell Corp. 422 E. Monroe St. South Bend, Ind. 46601 cost: under $2.00
Optistick	A clear plastic, flexible ruler may also be used. These materials are used to estimate the diameter of the pupils	Bernell Corp. 422 E. Monroe St. South Bend, Ind. 46601 cost: under $.50
Eye patch	One with elastic strap around back of the head is recommended.	Bernell Corp. 422 E. Monroe St. South Bend, Ind. 46601 cost: under $.50
Toys: rings, blocks, balls	Should not exceed 3-4 inches in diameter; should not provide sound cues when handled.	Classroom
Large, clear colored plastic pop beads; finger puppets (optional)	Fisher Price	Toy store Classroom

SECTION I: GROSS MEASURES OF VISION

Gross measures of vision are general indicators of whether vision is present or not. They are global indicators of the presence or absence of light perception, and include reflexive responses such as the blink reflex and pupillary constriction to light.

There are no intervention strategies for the behaviors assessed in Section I as blink refelx and rate, and pupillary responses are all reflexive. The information obtained, however, is important medically and should be shared with an opthamologist. As indicated after individual tests in the following pages, the presence or absence of these responses may be indicative of a variety of medical conditions; in addition, this information can help an eye specialist to determine the degree of vision present. A summary form for the information gathered is found in Appendix A and should be used to share the results of the assessment with an eye specialist.

GENERAL OBSERVATIONS

Setting: Classroom, cafeteria, school yard, hallways.

Materials: No special materials

Procedures:

1. If you are confident answering the questions below on the basis of your familiarity with the student, do so. If you are uncertain, observe the student for 3-5 minutes in at least 3 of the above settings.
2. Briefly describe the student's behavior in response to the questions below.

Does the student move purposefully toward objects and people in his/her immediate environment, e.g. approaches another student and reaches for toy;moves toward watering fountain to indicate thirst, etc.?

Does the student consistently avoid or move away from people or objects in his environment, e.g. runs away when approached by peer; turns away when presented with undesired materials, etc.?

Does the student avoid obstacles when moving in his environment, e.g., stops at closed door, navigates around chairs and tables, etc.?

Describe any other behaviors you feel are relevant to the student's visual functioning, e.g., consistent head tilt or turn, persistent squinting or rubbing eyes, brings objects very close to eyes for examination, etc.

ASSESSMENT OF BLINK REFLEX

The first assessment item is the presence of a blink reflex. The relationship between blink and vision is not absolute. The absence of a blink reflex does not mean that the child is totally blind and the presence of the blink reflex does not mean that the child has vision. The presence or absence of a blink reflex is, however, important information for the teacher to collect and share with an ophthalmologist. There are two sets of procedures used in assessing the presence of a blink reflex.

Procedure 1 for assessing the blink reflex is described on the facing page.

Blink Reflex - Procedure 1

Setting: Classroom, normal light levels

Materials: The teacher can use her open hand or a small soundless toy.

Procedures:

Position your hand or object 12" in front of student's face at eye level.

Quickly move your hand/object toward the student's eyes, stopping suddenly 2" from the eyes. The movement must be fast and well controlled to obtain an accurate response. Wait an interval of an least one minute between responses.

Response:

The response you are looking for is a blink. The student may blink rapidly several times in immediate succession, or may blink only once. Some students may show a delayed blink. In this instance, the blink may occur up to one full second after presentation of the stimulus.

Recording the data:

Perform 1-2 preliminary trials. Then perform 3 trials and record the data below.

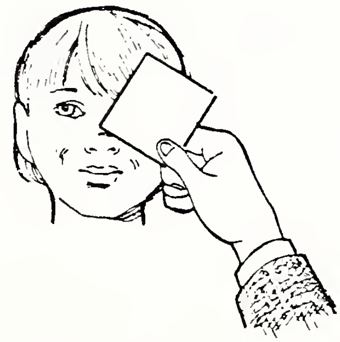
Trial	1	2	3
Response			

Total: __________

Comments:

Blink Reflex - Procedure 2

Procedure 2 is referred to as the "threatening gesture test". Each eye is assessed separately and then both eyes are assessed together. During assessment of the student's left eye the right eye is occluded by a blank, white 5 x 7" card or an occluder. The occluder is held 3-4" in front of the right eye at the angle shown in the drawing below.



When the student's right eye is assessed, the left eye is occluded in the same fashion. Both eyes are then assessed simultaneously without the use of an occluder.

Blink Reflex - Procedure 2

Setting: Classroom, normal light levels

Materials: The teacher can use her open hand or a small soundless toy.

Procedures:

Occlude the right eye.

Position your hand or an object 12" in front of the student's left eye at eye level.

Quickly move your hand/object toward the student's eye, stopping 2" in front of the eye, and back out again 3-5 times in rapid succession.

Immediately move your hand/object toward the student's eye again, but move your hand only 1-2". The student will blink again, despite the fact that the stimulus is at a safe distance. He will have "learned" to blink.

Repeat procedure a total of 3 times for the left eye.

Occlude left eye and repeat 3 times for the right eye.

Repeat 3 times for both eyes.

Response:

You are looking for a blink after the last presentation of the object, when you have moved it only 1-2". The student may blink once, several time rapidly, or may show a delayed blink up to 1" after presentation of the stimulus.

Recording the data:

Perform 1-2 preliminary trials. Then perform and record 3 trials for each eye and 3 trials for both eyes together.

Right Eye			Left Eye			Both Eyes		
Trial 1	Trial 2	Trial 3	Trial 1	Trial 2	Trial 3	Trial 1	Trial 2	Trial 3

Total R: ________ Total L: ________ Total Both: ________

Comments:

Blink Reflex - Procedure 3

A third procedure for assessing the presence of light perception is found on the facing page. This procedure is appropriate for non-ambulatory students but may also be used with other severely handicapped students who will lie quietly in a supine position. If you have observed clear responses or clear lack of responses with the previous procedures, you do not need to carry out this procedure.

Blink Reflex - Procedure 3

Setting: Classroom, normal light levels

Materials: Teacher's hand, penlight

Procedures:

The student should be in a supine position with a small amount of flexion at the neck. The hips and knees should be well flexed. Kneel or sit at the student's head.

Position the penlight so it shines into the student's face at a distance of 12-13" (33 cm) at midline eye level.

Hold your other hand flat and move it between the light and the student's face, observing for a blink reflex as you do so.

Response:

The blink reflex as described in the two previous tests.

Recording the data:

Perform 1-2 preliminary trials. Then perform 3 trials and record the data below.

Trial	1	2	3
Response			

Total: ______________

Comments:

ASSESSMENT OF BLINK RATE

The student who fails to demonstrate a blink reflex should be observed closely for two 2 minute periods of time, one period when the student is on task, the other when the student is at rest. The number of blinks during each 2 minute period should be recorded with "hash" marks on the individual recording form in the spaces provided.

The "normal" rate of blinking ranges from 2-28 times per minute. During periods of concentration the rate may go as low as 2 per minute. The rate may rise to as high as 28 per minute during conversation. A total absence of blinking or an extremely low (e.g., less than 2 blinks per minute) is a cause for concern. The absence (or very low rate) of blinking indicates that the function of the eye may become impaired. Blinking is a maintenance mechanism which distributes tears to remove dust dust and lubricates the cornea. Distribution of tears prevents drying of the cornea and protects the eye from infection. An absence of blinking requires medical attention to prevent drying of the cornea.

Record your observations below:

Student on task	☐	(total # of blinks) / 2 minutes)	=	______	blinks per minute
Student at rest	☐	(total # of blinks) / (2 minutes)	=	______	blinks per minute

ASSESSMENT OF PUPILLARY CONSTRICTION RESPONSES

The next response to be assessed is pupillary constriction. If the student's eyes respond to light by pupillary constriction there is some amount of light perception. The opposite condition (failure to constrict) does not necessarily mean the child lacks light perception. There are a variety of other neurologic and drug effects which could account for abnormal pupil responses.

There are two procedures to conduct in assessing pupillary constriction. The first is observation of each eye's ability to constrict separately and, second, equal rate of constriction when both eyes are observed together.

Pupillary Constriction - Procedure for Each Eye Alone

Setting: This procedure should be conducted in subdued lighting conditions. This is very important! The student should be facing toward a wall that has no windows or areas which differ greatly in color or illumination. These procedures should not be done in a totally dark room but should be done in a part of the classroom (or in a separate room) with the lights off. The subdued lighting will make pupil constriction more dramatic.

Materials: Penlight, clear plastic ruler or optistick

Procedures:

Position the student in the area of subdued light and wait 2-3 minutes for the student's eyes to adapt to the lower light level.

Without using the penlight, observe the student's pupils and record the following:

Are both pupils equal size?	____ yes	____ no
If unequal, which is larger?	____ right	____ left

Draw within the iris diagrams the actual size and shape of the student's pupil. These iris diagrams are drawn to scale; hold the ruler 3-4 inches in front of the student's eyes with your thumb and second and third fingers as shown. Place the tip of your index finger against the temple of the student to stabilize the ruler. Estimate the diameter of each pupil in milimeters.

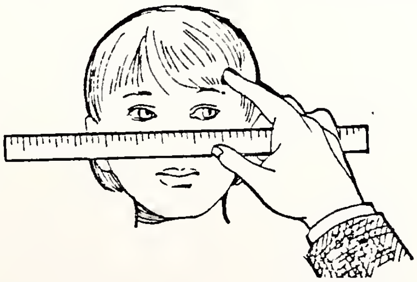


Figure 2.

Right eye __________ Left eye __________

Fill in pupils on the diagrams below and be sure to include any irregularity of shape or size.

right eye left eye

(Note: The student's right eye will be on your left and vice versa.)

With the penlight turned off, position it 4-6" in front of student's right eye.

Turn the light on and shine it straight into the student's eye, observing the pupil for approximately 2 to 3 seconds before turning off the light. Since the response occurs very rapidly, there is no need to continue shining the light after several seconds.

Wait at least one minute between trials. Perform the procedure 3 times for the right eye and 3 times for the left eye.

Response:

You are looking for constriction or shrinking of the pupil. This response occurs very rapidly. If the student blinks, turns his head away, etc., you may fail to observe it. Record only trials in which you have observed the pupil continuously for the first 2-3 seconds after the light is turned on.

Recording the data:

Perform 1-2 preliminary trials. Then perform 3 trials for each eye.

Right eye

Trial	1	2	3

Total ______

Left eye

Trial	1	2	3

Total ______

Pupillary Constriction: Both Eyes Together

After assessing each eye separately, pupillary constriction should be assessed in both eyes simultaneously. This procedure requires the teacher to look quickly from one eye to the other as a large light stimulus is presented. Again, the response occurs within the first few seconds.

Unequal pupil constriction may indicate that a neurological deficit is present. The deficit may be part of the central brain damage which produced the severely handicapping conditions in the student or there may be a peripheral or transient deficit present.

If the student's unequal pupils are due to damage in the central nervous system, there is less likelihood that the underlying condition can be corrected. There are, however, more transient conditions which can cause unequal pupil responses and which can be treated medically or surgically. Some examples are tumors or pressure on the brain caused by a malfunctioning shunt. Unequal pupil constriction may also indicate an acute eye condition such as drug effects, injury to the eye, or damage to certain cranial nerves.

In any case, the student's ophthalmologist should be alerted to the results of this assessment and he/she should determine the underlying cause for unequal pupil responses.

If the student's eyes fail to constrict, he/she may be totally blind (no light perception = NLP). There is, however, a condition referred to as "tonic pupil" in which the pupil is immobilized but the student has vision. Tonic pupil may be caused by tumors, or other central nervous system disorders, some of which are correctable. Tonic pupil can also cause generally unequal pupil size. In those cases, only one pupil may react or both may react to light, but one noticeably more so than the other.

Pupillary Constriction: Procedure for both eyes together

Setting: Position the child so the stimulus can be presented quickly. This may mean moving the student close to the window where the shades are drawn, or to a table where a lamp is positioned. This procedure may require 2 adults, one to activate the light source (turn on the lamp, quickly raise the shade, or flick on overhead lights) and the other adult to observe both eyes for simultaneous pupil constriction.

Materials: Large table lamp, clip on lamp with a bare bulb, light from windows, or overhead lights can be used. The source of illumination must reach both eyes simultaneously and be of equal brightness in both eyes.

Procedures:

Position the student and yourself so you are able to see directly into the student's eyes.

Activate (or cue your assistant to activate) the large light stimulus.

Quickly look from one eye to the other and observe the student's pupils for two to three seconds before deactivating the light source.

Wait 1 minute between trials and repeat the procedure for a total of 3 trials.

Response:

You are looking at the rate of constriction, i.e., is the speed of constriction the same in both eyes? As with the previous procedure, the response occurs within the first seconds after presentation of the stimulus.

Recording the data:

Did pupils constrict at the same rate?

Trial 1 _____ Trial 2 _____ Trial 3 _____

If pupil constriction rate was unequal, which pupil constricted faster?

Left _____ Right _____

ASSESSMENT OF PUPILLARY CONSENSUAL RESPONSE

The next pupillary response to be assessed is the pupillary consensual response. This response can be described as pupillary constriction in both eyes when only one eye is presented with a light stimulus. The amount of constriction in the non-stimulated eye is usually less than in the stimulated eye.

Failure to demonstrate a pupillary consensual response is an indication that the pathways to, or the brain stem itself, are damaged. This may be due to: 1) a lack of light perception in one eye; 2) a permanent neurological deficit elsewhere, or 3) one of the more transient conditions such as temporary drug effects.

The size of the pupil will normally fluctuate very slightly during your observation. This is due to the small variations in blood flow to the eye and corresponds with the student's heart rate and respiration. The normally small amount of dilation seen with each inspiration of air (and contraction of the pupil during expiration) is referred to as respiratory hippus. This is differentiated from the more obvious rapid and rhythmical fluctuation of the pupils caused by a spasmodic tremor in the iris. This is also referred to as "hippus" and represents a pathological condition important for the student's physician to know about.

If the student's pupils constrict during the preceding assessment (or if they fail to constrict but you feel that the student does have some vision) go on the assessment of the eyes working together.

Pupillary Consensual Response

Setting: Same as above. Make sure the lighting condition in the classroom is the same as it was during the earlier assessment. The student should be facing away from the bright light sources in the classroom.

Materials: Penlight

Procedure:

Position the unlit penlight so it will shine directly into the student's right eye at a distance of 4-6 inches.

Look directly into the student's left eye and turn on the light.

Watch for pupillary constriction in the eye not being stimulated. Watch for two or three seconds and then turn off the light.

Wait at least 1 minute between trials and follow the order of presentation in the chart shown below.

Response:

You are looking for constriction in the eye not being directly stimulated.

Recording the data:

Perform 1-2 preliminary trials, then follow the order below and score:

Trial	Light to:	Observe:	Response
1	right eye	left eye	
2	left eye	right eye	
3	left eye	right eye	
4	right eye	left eye	
5	left eye	right eye	
6	right eye	left eye	

SECTION II: DO THE EYES WORK TOGETHER?

Following the determination that a student has some light perception, the next aspect of vision to assess is whether or not the eyes work together. Ocular coordination is assessed through several measures, including bifoveal fixation, cover tests, and evaluation of accomodative convergence. These procedures are described on the following pages. The section concludes with a discussion of the meaning of assessment results.

If a student's medical records indicate vision in one eye only, bifoveal fixation and the cover tests are inappropriate assessments. However, you may still evaluate monofoveal fixation and convergence using procedures described for these tests but evaluating only the one eye in which there is vision (see the decision model at the end of Part II).

INTRODUCTION

The eyes have evolved in their structure and function to produce binocular vision. During regard of an object (a ball for instance) the two eyes receive slightly different images. This is due to the 2-2½" distance between them. The brain fuses the 2 slightly different views and makes from them a clear single image. This process is referred to as fusion. The diagram below represents the process of fusion.

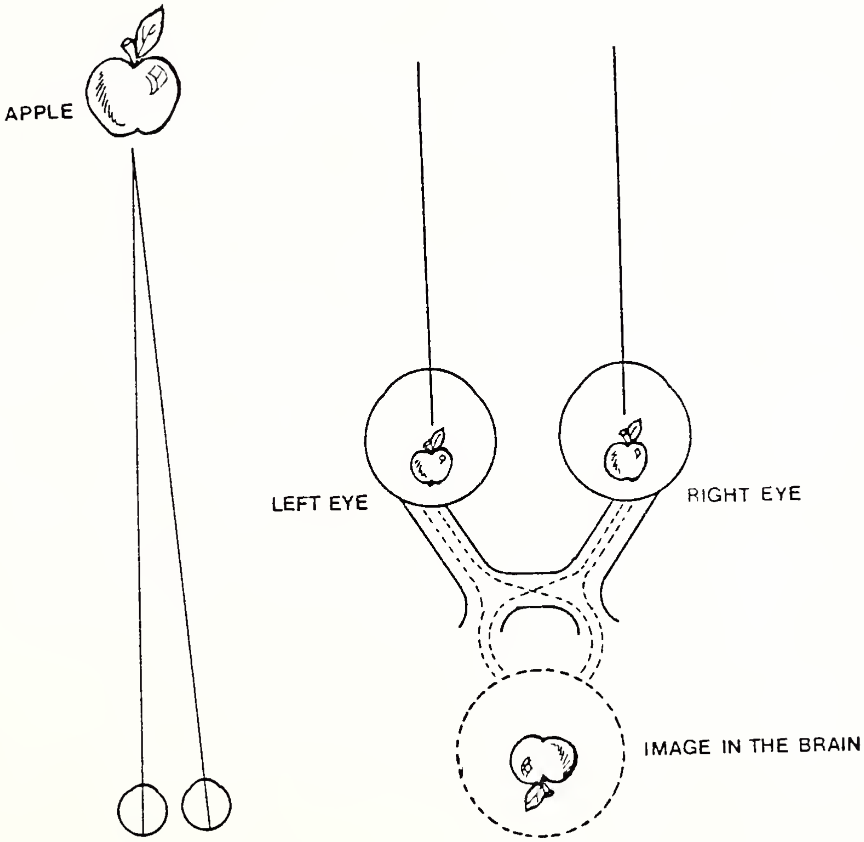


Figure 3. Both eyes are looking at a ball. An image of the ball is formed on the retina at the back of each eye. Each eye sends the image of the ball to the brain. The brain combines the images (one from each eye) and fuses them into one.

The development of fusion is dependent on several factors including proper alignment of the 6 extraocular muscles which control each eye and good vision in each eye.

There are several ways to measure the use of both eyes together. The first assessment is a measure of bifoveal fixation. Bifoveal fixation is a

prerequisite for fusion. When a normal eye looks at an object, the image falls on the fovea (the most sensitive part of the retina). This is called central fixation. One of the causes of failure of the eyes to work together is eccentric fixation. Eccentric fixation occurs when the image falls on another portion of the retina. Central and eccentric fixation are shown in the diagram below.

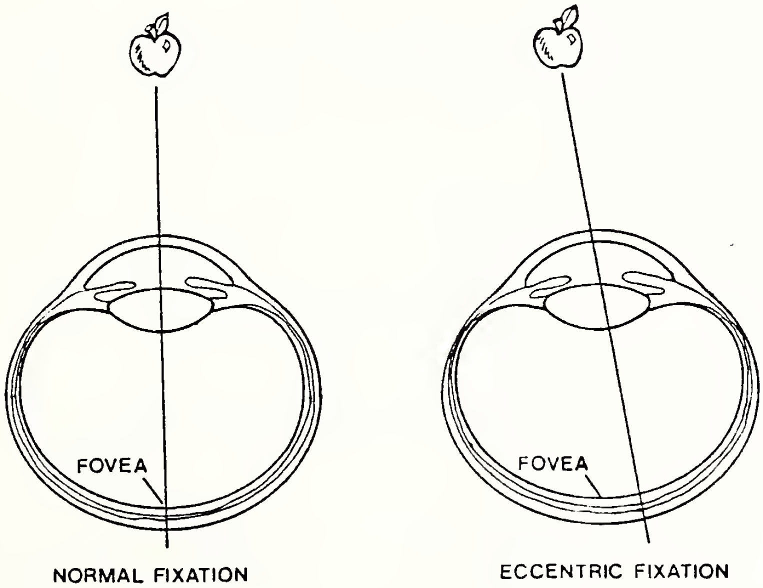
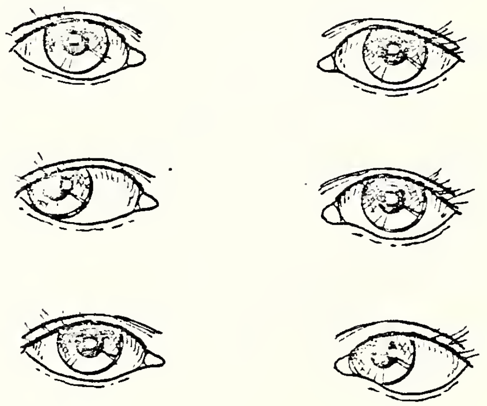


Figure 4.

Eccentric fixation may be due to turning of one eye. The turned eye receives an image which is too different to be combined with the image received by the other eye. This results in diplopia (double vision). Double vision is uncomfortable and soon results in suppression of the less clear image.

ASSESSMENT OF BIFOVEAL FIXATION

Assessment of bifoveal fixation is done first by comparing the position of the corneal light reflection. When a lighted object is held 12-13" (33 cm) from a person's eyes at midline and nose level, the reflection will be centered in the pupil or just slightly to the nasal side of each pupil. The reflection should be seen in the same relative location in both eyes. Refer to the pictures below for examples of the corneal light reflection.



corneal light reflection in normal eyes

corneal light reflection when right eye rolls out (exotropia)

corneal light reflection when left eye rolls in (esotropia)

Figure 5.

This is a difficult response to observe accurately, and the procedure must be practiced on other adults until you know what you are looking for.

Bifoveal Fixation

Setting: Classroom or a dark room. The dark room has the advantage of making the lighted stimulus more dramatically visible to the student, thereby increasing the probability that the student will look at the light stimulus for 3-5 seconds.

Materials: Penlight, plastic pop bead (optional)

Procedure:

Position the unlit penlight 12-13" (33 cm) from the student's face and level with the tip of the student's nose.

Be certain your own face is directly centered behind the penlight. Your eyes should be directly opposite the student's eyes, neither above, below, nor to the right or left.

Turn on the light and observe the position of the light in each cornea. If the student's eyes are wandering or he is looking elsewhere, you may flick the light on and off a few times to obtain his attention. Do not wave the penlight repeatedly back and forth across the student's line of vision in an attempt to center it in the pupils of both eyes. You are looking for an active fixation response on the part of the student. If the student simply fails to attend to the light, do not score the trial and re-present it.

Wait at least 1 minute between trials and repeat for a total of 3 times.

Response:

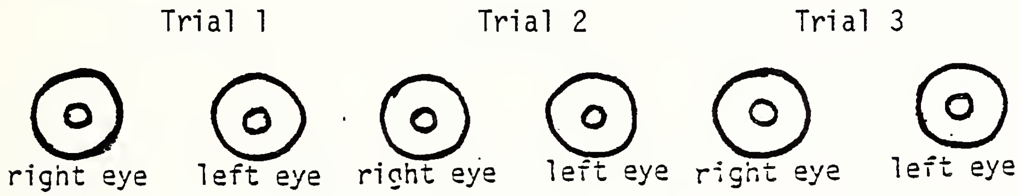
You are looking for the reflection of the lighted stimulus in the same relative location in each eye. If the student is fixating on the light this location will be in the center of both pupils. If one of the student's eyes rolls inward or outward, you will observe the light in the center of the pupil of the eye that is not turned in or out, but the light will be reflected elsewhere (e.g., on the iris) of the turned eye.

A "false" correct response may be observed if the student is in fact gaging or fixating on a point beyond the light. To verify the student is actually actively fixating on the light, move it slowly one inch to

the right or left. If the student tracks the light and it remains in the center of each pupil as the eyes move to the right or left, this is an indication that bifoveal fixation is present. Failure to track may indicate a lack of bifoveal fixation or a variety of medical conditions and should be reported to the eye specialist.

Recording the data:

Perform 1-2 preliminary trials. Perform 3 trials and draw the location of the reflection on each trial in the diagram below:



COVER TEST: ASSESSMENT OF MUSCULAR COORDINATION

The second assessment procedure to determine if the eyes are working together is based on the work of Dellande (1976) and is referred to as the "cover" test. This procedure requires fixation on a lighted object or any other interesting object no larger than 3 x 4". This procedure can be done in normal light levels or subdued lighting. It can also be done in a dark room if the light stimulus is used. During fixation a plain white card approximately 5 x 7" should be used as an occluder. The card is held 2-3" in front of one of the student's eyes and the uncovered eye is observed for a "shifting" movement. It is unnecessary to watch for the corneal light reflection during this procedure, but instead watch for any eye movement to either side or up or down.

The object of this test is to detect muscle imbalance which the eyes can ordinarily correct for when allowed to work together. If any level of binocular vision is present, an object held approximately 12" away will provide a strong enough stimulus for the eyes to work together. This is done through a complicated feedback system which coordinates the visual input from both eyes. If the "good" eye is occluded, the feedback system no longer operates and a weak eye will deviate from fixation by rolling in, out, up, or down. If the unoccluded eye deviates it is an indication that very little input is generally received by that eye, and the eye's connections to the feedback system are weak.

The movement of one or both eyes out of alignment is observed in two conditions which differ only in their seriousness. An eye either has a tendency to deviate (which is not readily apparent during casual observation) or the eye has a manifest deviation which is more easily observed. The cover test presented here makes possible observation of the more manifest condition. Additional assessments are required to reveal less serious tendencies towards deviation and they should be performed by the student's eye specialist as the tendency to deviate may not be observed and may worsen over time.

When performing this test, some students may resist placement of the occluder in front of one eye while showing no resistance to occlusion of the other eye. This may be an indication that one eye has significantly better vision. If resistance behaviors such as pushing the occluder away or head movements to see around the occluder are observed during this assessment procedure, a note should be made on the recording form. The note should state which eye the student resisted occlusion of as well as a description of the resistance behavior.

Cover Test

Setting: Classroom or subdued lighting levels (optional).

Materials: Occluder or index card, penlight or visually interesting toy no larger than 3 x 4".

Procedure:

With one hand, hold the visual stimulus 12-13" (33 cm) in front of the student, at midline and level with the tip of his nose and watch for fixation.

With the other hand, hold the occluder in your lap for 3-4 seconds.

While the student is fixating on the stimulus, quickly lift the occluder and position it 2-3" in front of the student's right eye. The occluder must block the right eye's view of the stimulus, as shown below, for 2-3 seconds in an attempt to break fusion of the covered eye. However, the stimulus itself remains clearly in the line of vision of the student's left eye.

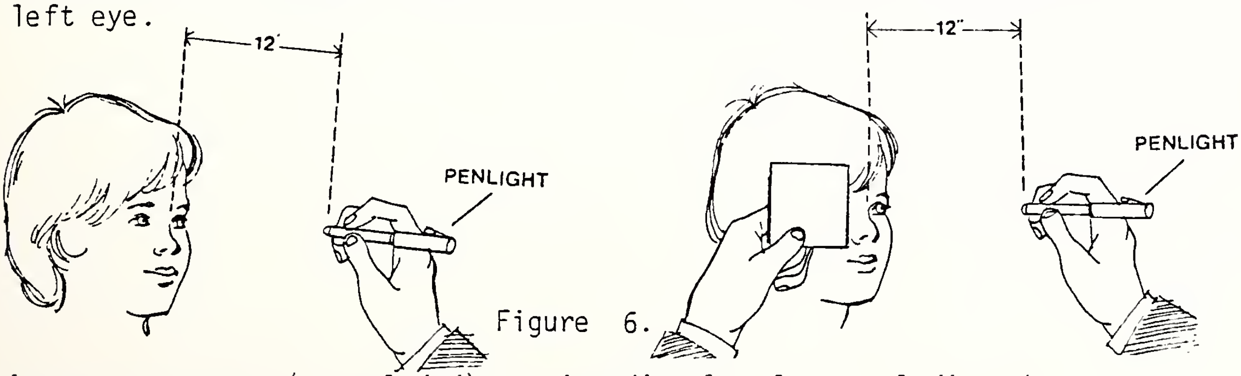


Figure 6.

Observe the left (unoccluded) eye immediately after occluding the right eye.

Wait one minute between trials and complete 6 trials following the order below.

Response:

You are watching for any shifting movement in the unoccluded eye, regardless of direction. The shift occurs rapidly after the other eye is occluded.

Recording the data:

Perform 1-2 preliminary trials. Perform 6 trials following the data sheet below:

Trial	Occlude	Observe	Shift?	Direction
1	R	L		
2	L	R		
3	L	R		
4	R	L		
5	L	R		
6	R	L		

Comments:

ASSESSMENT OF ACCOMODATIVE CONVERGENCE

The final set of procedures for determining the presence of ocular coordination is assessment of the presence of the accommodation reflex (or accommodative convergence). The ability to visually fixate on objects at varying distances (up to 10 feet) for the eyes is due to the presence of the accommodation reflex. This is also referred to as accommodative convergence. Accommodation is adjustment of the thickness, curvature and power of the lens through action of the ciliary muscle. Adjustment of the ciliary muscles focuses objects at different distances clearly on the fovea. In addition to the change in shape of the lens, two other processes occur during the accommodation reflex. One is contraction of the pupil and the other is convergence. Convergence is directing the visual axes of the eyes inward toward midline as an object is brought closer to the eyes. Figure 7. represents convergence of the eyes during fixation of the eyes at 3 distances.

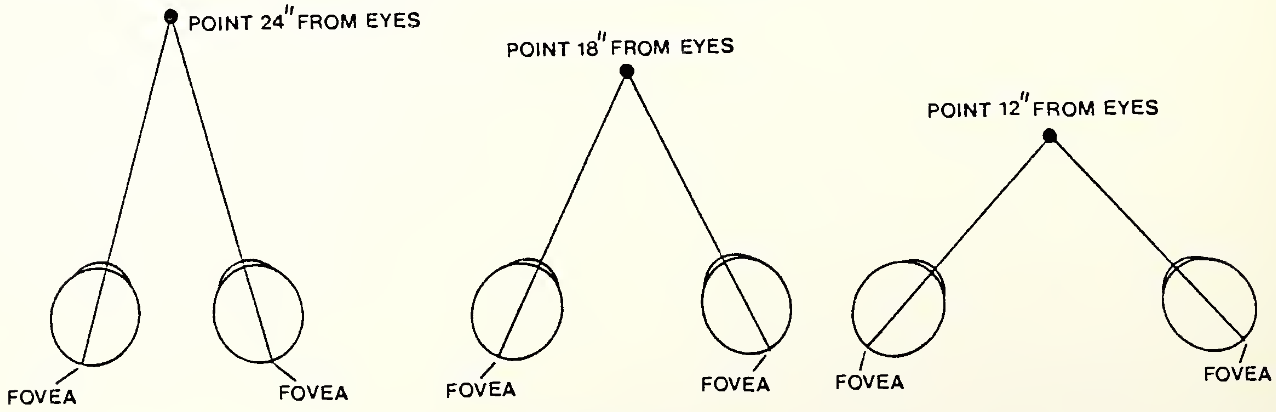


Figure 7.

As the object is brought closer to the eyes, the eyes turn inward toward the nose more and more. The eyes have the ability to converge to a distance 3-4" from the eyes at which time convergence (and the corresponding fusion of the single mental impression) is broken.

Accomodative Convergence

Setting: Classroom

Materials: Penlight inserted in pop bead (optional), ruler

Procedure:

Present the lighted object at midline 16-18" from the tip of the student's nose. You must obtain fixation on the object (you may flick the light on and off a few times to get the student's attention) in order to do this assessment. Use whatever fixation response you obtained in the previous assessment as bifoveal fixation is not a prerequisite.

Move the lighted object toward the tip of the student's nose. It should take 3 seconds to move the object a distance of 12-14".

Observe the student's eyes during movement of the object. When convergence breaks, as described below, record the distance between the object and the student's nose.

Response:

You are watching for a number of responses. Normal convergence will involve both eyes turning inward to remain fixated on the object. When the object is 3-4" from the eyes, convergence breaks, in that the eyes can no longer form a single image. When convergence is broken, the student may 1) blink and refixate or 2) one or both eyes may roll up, down, or sideways. However, many persons will continue to converge on an object until it touches the nose, despite the fact that they are seeing a double image when they do this.

You may thus observe a number of responses. The student may hold his head in midline and one or both eyes may roll up, down, or sideways when convergence is broken. Or, the student may turn his head to watch the object with one eye as it approaches.

Recording the data:

Perform 1-2 preliminary trials. Perform three trials and record the data on the following page. If deviation occurs when fixation is broken, indicate which eye and the direction of the deviation. If convergence is not observed, indicate no response.

Trial Number:	1		2		3	
Distance at which convergence is broken						
Deviation observed	L	R	L	R	L	R

If the student's head deviates to either side, record the direction of the head turn and the preferred eye below for each trial.

	 head turn to left R eye is preferred			 head turn to right L eye is preferred		
Trial						

If you have observed convergence, repeat the procedure one more time and watch for pupillary constriction during convergence. Was constriction observed? ______________________________

<u>Comments</u>:

Meaning of Assessment Results

Failure to fixate with both eyes and poor performance during assessment using the cover tests and accomodative convergence are indications that the student may have strabismus. Strabismus is a visual disorder caused by uncoordinated eye muscles. Strabismus is often referred to by ophthalmologists as "squint". The word squint in this case is <u>not</u> used in the same way it is usually used in lay terminology. "Squint" used synonymously with strabismus refers to this specific visual impairment and not to the behavior observed in persons adjusting to bright sunlight or when trying to see an object more clearly.

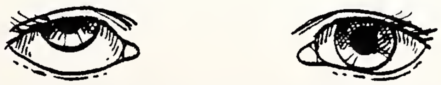
Strabismus can be expressed in a variety of terms depending on the direction of the deviation and the typical manifestations of the condition. <u>Phorias</u> are conditions in which the eye has a <u>tendency</u> to deviate. <u>Tropias</u> are conditions in which the deviation is <u>manifest</u> and more fixed. The most common terms describing strabismus are:

esophoria - a <u>tendency</u> of one or both eyes to turn inward.

esotropia - a <u>manifest</u> turning inward of one or both eyes (<u>convergent</u> strabismus or crossed eye).

exophoria - a <u>tendency</u> for one or both eyes to turn outward.

exotropia - a <u>manifest</u> turning outward of one or both eyes (<u>divergent</u> strabismus or wall eye).



hyperphoria - a <u>tendency</u> for one eye to deviate upward.

hypertropia - a <u>manifest</u> upward deviation of an eye.

In addition to the terms used to refer to the direction of the deviation, there are other terms which are used to describe the type of strabismus present. The most commonly used terms are:

a. unilateral - when the same eye always deviates.

b. alternating - when either eye deviates, the other remains fixed.

c. constant - when the deviation is always observed.

d. periodic - when the eyes are occasionally free from deviation.

Some persons demonstrate an "alternating" condition. Assessment data from these persons will show first one eye, then the other eye, moving in a particular direction. In many persons with alternating conditions, there is adequate vision in both eyes although they fail to work together. The ophthalmologist will be able to confirm the presence of an alternating condition and determine its cause.

The presence of strabismus is not uncommon. A diagnosis of strabismus is of concern primarily because strabismus often results in prolonged suppression of the images received by the deviating eye. Visual acuity in this eye becomes <u>permanently</u> reduced due to nonuse. This condition has many names, but is most often referred to as amblyopia ex-anopsia or suppression amblyopia. Many students with strabismus, therefore, are essentially "one-eyed". If the good eye becomes diseased or injured in later life, the student may become extremely visually limited or blind.

The presence of strabismus in a student over the approximate age of 6 (when complete correction of the deviation becomes unlikely) does not mean the student is unable to adequately perform the majority of educational tasks. S/he is merely using visual information primarily from the good eye.

For the very young student with strabismus, correction of the deviation is important primarily to prevent the development of amblyopia. There are, however, several other reasons why correction (with the opportunity to develop binocular single vision) is stressed. Binocular single vision is superior to monocular vision in the following ways:

1) the field of vision is larger than for a one-eyed person;
2) the blind spot which is found normally in each eye is compensated for by the other;
3) the combined binocular visual acuity is greater than monocular acuity; and
4) an individual's assessment of depth perception is more accurate in stereoscopic vision.

For all of the above reasons, both medical and educational interventions to facilitate coordinated use of the eyes should be persued.

SECTION III: ASSESSMENT OF PERIPHERAL FIELDS

This section evaluates indicators of the student's peripheral vision, i.e., vision for objects which are not in the student's central line of vision. This procedure is appropriate for students who have a clear bifoveal or monofoveal fixation response. If a student has vision in only one eye, that eye should be assessed singly. The procedure is also appropriate for students with strabismus, although the deviating eye may fail to respond due to amblyopia.

ASSESSMENT OF PERIPHERAL FIELDS

Adequate peripheral vision is important for the maintenance of coordinated ocular movements - the use of both eyes together to produce binocular single vision. Normally, most objects in our environment are first brought to our attention in our peripheral visual field. It is there we determine the importance of the object subconsciously and we then regard those objects of importance or interest using central vision.

The procedure for assessing peripheral fields is done in a totally dark room. The procedure is referred to as the "two penlight test". To begin, both penlights are off with one penlight held at midline, nose level and 12-13" in front of the student's face. A second penlight is held at the student's midline but 12-13" above the position of the first penlight. The centrally positioned penlight is turned on. When the student student is looking at the centrally positioned light, it is turned off while the second light is turned on. The on/off controls must be activated simultaneously. The student should immediately shift his/her gaze to the second penlight. A total of 8 peripheral points are assessed as shown in the figure below.

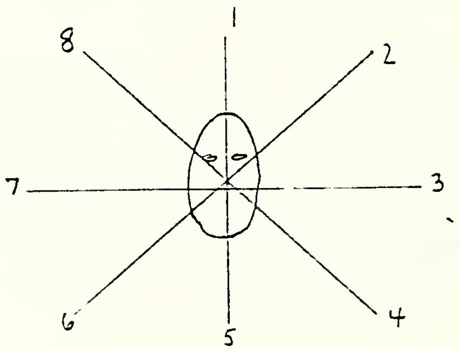
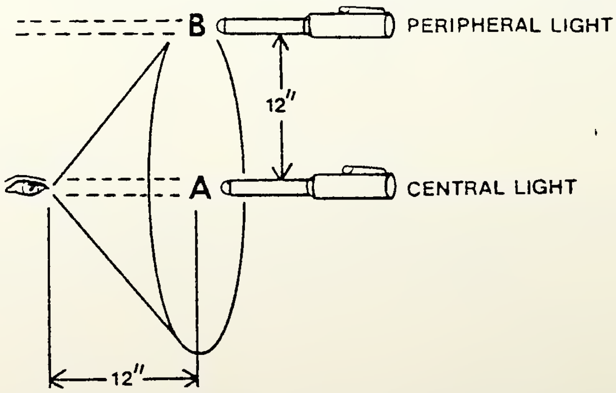


Figure 8.

When conducting this test, it is extremely important that the two penlights are presented in the same plane, e.g., if the central penlight is at 10-12" from the student's face, the peripheral penlight should also be at 10-12". The second penlight should also be parallel to the first penlight, and not pointed at an angle toward the child's face.



Both eyes are assessed together, then each eye is assessed separately. During assessment of each eye alone, the other eye should be covered with an eye patch. Both eyes are then assessed together one more time. This procedure may require two or three sittings.

Peripheral Field - Two Penlight Test

Setting: Dark room.

Materials:

Two penlights of equal size and intensity with silent switches; eye patch.

Procedure:

Position yourself directly in front of the student at eye level. With both penlights off, position one light 12-13" from the student's face at nose level. Position the second light 10-12" above the student's nose at midline, with the penlight parallel to the floor.

Turn on the central penlight and obtain fixation.

After no more than 2-3 seconds of fixation, turn off the central penlight while simultaneously turning on the second penlight. Watch for gaze shift.

Repeat, following the numbered positions on the data sheet below.

Response:

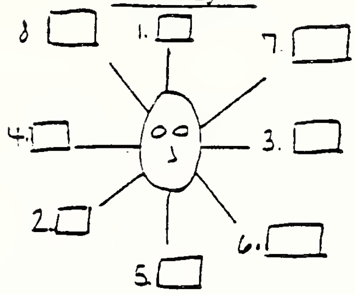
You are looking for a shift of gaze from the central to the peripheral light. In addition, when you assess the eyes together, observe whether or not the shift of gaze is symmetrical - do both eyes shift simultaneously and in the same direction? All responses should occur within 3 seconds.

Recording the data:

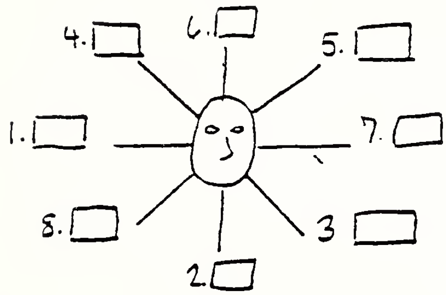
Perform 1-2 preliminary trials. Conduct the assessment on both eyes, following the order of the numbered positions on the diagram below. Then patch the left eye and assess the right eye and vice versa. Then complete the assessment once more on both eyes together.

Two Penlight Test - continued

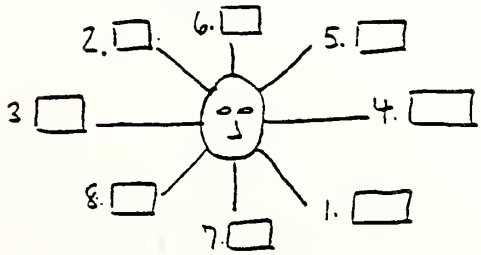
Both Eyes



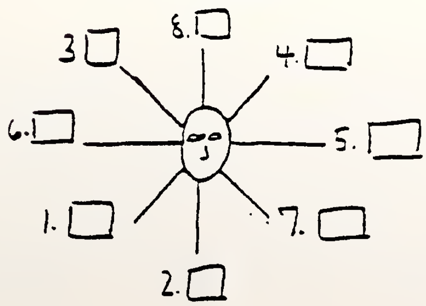
Right Eye



Left Eye



Both Eyes



SECTION IV: TRACKING AND GAZE SHIFT

TRACKING

Setting: Classroom, normal light levels

Materials: 1 small, highly reinforcing object (a food item, cup of juice, highly preferred toy); 1 small, soundless object (penlight in a popbead, mirror, sparkler toy) that is novel to the student; teacher or other familiar person.

Procedures:

Seat yourself across from the student so that your face is directly opposite from the student's face.

Present the object at nose level 12" from the student's face and obtain fixation.

When fixation is obtained, slowly move the object horizontally to the right 6-8 inches. It should take 2-3 seconds to move the object this distance. Observe and record.

If the teacher or other familiar person is the stimulus to be tracked, a second observer is needed. Have the observer seated across from the student at eye level. Stand behind the observer and call the student's name, wave your hand, etc. until the student looks at you. Then walk slowly to the right and out of the student's line of vision. Have the observer note whether the student tracks your movement.

Perform a total of six trials, following the right/left presentation and stimulus list on the following data sheet.

Response:

You are looking for a smooth continuous movement with the eyes remaining in symmetrical alighment with one another. However, several other responses are possible. Only one eye may track for the full distance, or one or both eyes may deviate while tracking. One or both eyes may also only track the object for part of the full distance. Finally, the student may track with his eyes only, with eyes and head simultaneously, or the head may follow the eyes. All of the information about a student's response should be recorded.

Recording the data:

Use the spaces following to record whether the left eye only, the right eye only, or both eyes track (L,R,B). If no tracking is observed, score (-). If both eyes track, note whether the eyes remain symmetrical (+), or if one or both eyes deviate as the student is tracking (-). In the third column, briefly describe the behavior of the student's head while tracking (e.g., eyes only, head follows eyes, etc.) In the fourth column describe any unusual aspects of the tracking behavior (e.g. right eye tracks only the first 1-2 inches, left eye tracks full distance).

STIMULUS	DIRECTION	TRACK (L,R,B)	SYMM	HEAD (describe)	OTHER (describe)
Reinforcer	R				
Novel Item	L				
Person	L				
Novel Item	R				
Person	R				
Reinforcer	L				

Total: L only ____ R only ____ Both ____

Vertical and Diagonal Tracking

Review the data above for horizontal tracking. If you have observed horizontal tracking, use the stimulus items that were most successful to evaluate vertical and diagonal tracking.

Use the same procedures as above, but follow the directions on the data sheet below.

DIRECTION	TRACK	SYMM	HEAD	OTHER
1. vertical overhead (↑)				
2. right upper diagonal (↖)				
3. left lower diagonal (↘)				
4. vertical downward (↓)				
5. right lower diagonal (↙)				
6. left upper diagonal (↗)				

SHIFT OF GAZE

Setting: Classroom, normal light levels

Materials: 3-4 small (2-4 inches square) visually complex objects such as small hand mirrors bull's eye targets, small kitchen utensils, which are novel to the student. Two to three objects known to be high in reinforcement value to the student. Based upon your familiarity with the student, select items which you think might prompt the student's curiosity. For some students pictures or photos may be appropriate; for others the objects may have to be quite large or of high contrast colors, or lit by a penlight. A 1x2 foot cardboard screen.

Procedures:

The student should be seated at a table or in his/her wheelchair with a lap tray. Seat yourself opposite the student with your face on the same plane, so you can easily observe the student's eyes.

Hold the screen perpendicular to the desk 10-12 inches away from the student. Behind the screen place two of the objects 6 inches apart. Quickly lift the screen and watch the student's eyes for 5 continuous seconds. Repeat 3 times, using different sets of objects on each trial.

Response:

You are watching for a rapid shifting of the eyes back and forth between the objects 3-5 times within the 5 second period. However, the response may be much slower and/or the student may shift gaze only once or twice.

Recording the data:

Score any shift of gaze within the 5 second period as a (+). Also note the number of shifts observed during the 5 second period.

OBJECTS	SHIFTS	# SHIFTS

Total ___________

SECTION V: REFRACTIVE ERRORS AND ACUITY MEASURES

A Review of Optic Principles

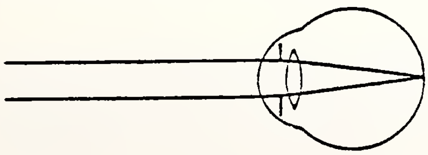
Optic principles form the basis of understanding and testing for the presence of refractive errors.

The visual sense has evolved to its present level because of the properties of our world. It is a world characterized by the presence of light. The objects, people, plants, etc. which comprise the environment in which we live all reflect light to our eyes. This reflected light travels to us through the air in straight lines which will be referred to as light rays.

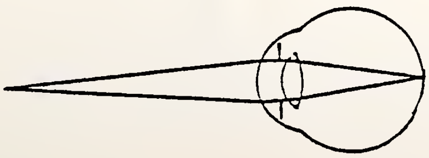
The speed of light rays is dependent on the medium through which they are transmitted. As light passes from one medium to another, the light rays are bent (refracted). Within the human eye are 2 types of transparent material which produce refraction; the cornea and the lens. The cornea produces about 75% of the refraction with the remaining 25% produced by the lens.

Objects at distances of 6 meters or more reflect predominately parallel light rays which enter the eye, are refracted by the cornea and lens and focus on a single point at the back of the eye. Objects closer than 6 meters, however, reflect more diverging light rays. In order for these diverging rays to focus on a single point, more refraction is needed. The lens of the eye, by changing its shape, provides the added refraction and a clear image is focused on the back of the eye.

In our daily lives we regard objects at variable distances within the 6 meter range. The lens is continuously producing a varying amount of refraction which is determined by the distance of the object of regard. Production of varying amounts of refraction is made possible by the ability of the lens to change its curvature. This property of the eye to focus clearly on objects at various distances is referred to as accommodation.



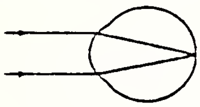
The eye viewing an object at a distance of 6 meters or more



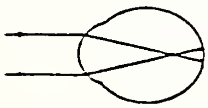
The eye "accommodating" to view an object at a distance less than 6 meters.

The pupil of the eye admits light rays reflected from our surroundings. The iris contracts or expands the size of the pupil and by doing so prevents light from going through the edges of the lens system where aberration would be produced. The light rays are then focused on the most sensitive part of the retina - the tiny pit called the fovea which is part of the depressed, highly sensitive, macular region. Cone cells are most numerous in this region which produces the most acute vision. In the normal act of looking we direct our line of sight such that the image will be formed in the macular region.

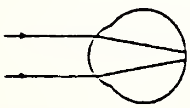
For a clear image to be produced, the distance from the cornea to the retina must be within a certain range (about 25 mm). This distance is focal length and it includes the range of image distances to which the lens system of the eye can adapt. For many people, the eye is either too long or too short for the focal length of its lens system. The image tends to focus in front of or behind the retina. In either case, a blurred image results. An eyeball which is too long produces myopia (near-sightedness) and an eye-ball which is too long produces myopia (near-sightedness) and an eyeball which is too short produces hyperopia (far-sightedness). Both conditions are referred to as refractive errors.



Normal Eye

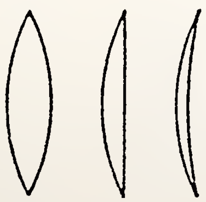


Myopia (near-sightedness)



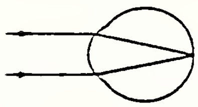
Hyperopia (far-sightedness)

The correction for refractive errors requires the use of lenses. For hyperopia a converging (convex, or positive) lens is used. A convex lens has the basic characteristic of being thicker in the middle than at the outer edges. Types of convex lenses are shown below.

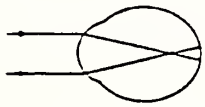


The pupil of the eye admits light rays reflected from our surroundings. The iris contracts or expands the size of the pupil and by doing so prevents light from going through the edges of the lens system where aberration would be produced. The light rays are then focused on the most sensitive part of the retina - the tiny pit called the fovea which is part of the depressed, highly sensitive, macular region. Cone cells are most numerous in this region which produces the most acute vision. In the normal act of looking we direct our line of sight such that the image will be formed in the macular region.

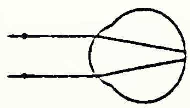
For a clear image to be produced, the distance from the cornea to the retina must be within a certain range (about 25 mm). This distance is focal length and it includes the range of image distances to which the lens system of the eye can adapt. For many people, the eye is either too long or too short for the focal length of its lens system. The image tends to focus in front of or behind the retina. In either case, a blurred image results. An eyeball which is too long produces myopia (near-sightedness) and an eyeball which is too long produces myopia (near-sightedness) and an eyeball which is too short produces hyperopia (far-sightedness). Both conditions are referred to as refractive errors.



Normal Eye

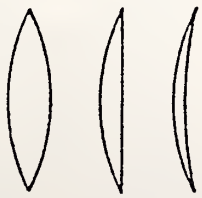


Myopia (near-sightedness)

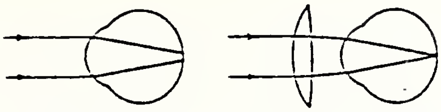


Hyperopia (far-sightedness)

The correction for refractive errors requires the use of lenses. For hyperopia a converging (convex, or positive) lens is used. A convex lens has the basic characteristic of being thicker in the middle than at the outer edges. Types of convex lenses are shown below.

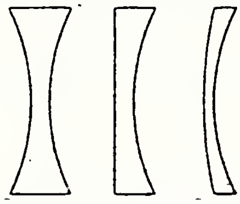


Use of this lens bends divergent light rays to that the rays can converge upon a single point on the retina.

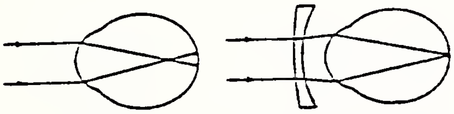


Hyperopia and its correction

For myopia, a diverging (concave or minus) lens is used. A concave lens is thinner in the middle than at the edges. Types of concave lenses are shown below.



Concave lens diverge parallel light rays slightly before the lens system of the eye directs the rays to a single point.



Myopia and its correction

The "power" of a lens is the focal length of that lens. Focal length, in turn, is determined by the lens material (plastic or glass) and the degree of curvative of the lens surfaces. The amount of correction is expressed in terms of <u>diopters</u>.

Testing for the presence of refractive errors is done through two procedures. An "objective" measure of acuity is completed with the use of an ophthalmascope. An examiner uses the ophthalmascope to observe the back (fundus) of the eye and estimate the eye's refractive power. Completion of an objective measure of acuity does not require communication skills on the part of the client but it <u>does</u> require that the client remain motionless (including the eyes) for 1-2 minutes. For many handicapped students, remaining motionless in a strange environment for even that amount of time is difficult. This may be complicated by the addition of miotic drugs in eyedrop form. The drops dilate the pupil and enable the examiner to adequately observe the eye but they also can cause distress to many students because of the mild stinging sensation and blurred vision they produce.

Another test which can give an estimate of visual acuity is the Visually Evoked potential. The VEP is a measure of the brain's electrical response to a visual stimulus; e.g., a light flash, alternating black and white squares, a moving pattern, etc. Electrodes placed on the scalp record the response in wave patterns. The "transient VEP" produced by abrupt stimulus changes shows complex wave patterns. The "steady states" VEP produced by repetitive stimulus changes shows cyclical wave patterns. Both types of VEP are used in measuring acuity through watching for variations in wave amplitude that correspond with changes in stimulus size.

These changes in wave pattern can then be compared with the wave patterns of other subjects with known acuity ratios. Attempts are now being made to assign acuity ratios to various wave patterns.

The VEP requires a minimal amount of cooperation. Subjects must keep their eyes open and oriented towards the visual stimuli for approximately an hour. Moreover, they need to remain as quiet as possible for the best results. Drawbacks to the VEP include the complexity and the expense of the equipment, the length of time required for the test, and the paucity of trained practitioners who can administer the test. (See Dobon and Teller, 1978 for more detailed information).

In addition to the difficulty in completion of the objective test with some students, it provides only an estimate which is then confirmed and/or refined by "subjective" measures.

The traditional subjective measure consists of presentation of one of many charts (the Snellen, the Illiterate E, etc.) to a client with the client required to report what he/she sees. Many skills are necessary to respond to the subjective test, including receptive language, attending skills, and a verbal or motor response mode.

There are a variety of subjective acuity measures (summarized below) which have been developed for young and handicapped children. Many teachers of severely handicapped and/or deaf-blind students may have access to some (or all) of these measures by developing a working relationship with specialized personnel (opthalmologists, optometrists, visually handicapped resource teachers, etc.). A brief review of available tests is presented below. The review includes a list of the prerequisite client behaviors needed for participation in each test and problems which may be encountered during test administration.

Review of Acuity Measures

Near Point acuity measures include the optokinetic nystagmus, preferential looking, forced choice preferential looking, operant preferential looking, operant preferential looking, and the non-pareil test.

Optokinetic Nystagmus (OKN) is a test originally designed for infants. It requires the infant to be awake, open-eyed and attentive. OKN is a series of responses that appear to be involuntary when a moving stimulus fills the visual field. The eyes fixate and move across the field, then rapidly correct back in the opposite direction to begin the fixation and correction cycle again. The procedure involves placing the infant under a display of moving stripes. Observers note the smallest stripe pattern width that elicits the OKN response. These widths are correlated with known acuity ratios. OKN required skilled observation and some sophisticated equipment (the canopy-like display screen, the pattern in various stripe widths, etc.). See Gorman, et. al. (1957, 1959) or Dayton, et. al. (1964) for more detailed information.

Preferential looking (PL) measures were first designed for infants by Fantz (1962). They are based on knowledge that infants presented with a patterned and a plain surface will consistently fixate more on the patterned surface. The PL procedure involves exposing the infant to stimulus pairs of black and white stripe patterns of various widths vs. grey field patterns. Observers watch the infant's eyes and record the direction, amount and duration of fixations on each stimulus. The acuity estimate is then determined by the smallest stripe width which causes differential fixation between striped and plain grey stimulus pairs. The requirements for the infant are more rigorous than for OKN measures. In addition to being awake and alert, the infant must be able to differentially fixate upon stimuli in the visual field.

Forced choice preferential looking (FPL) is a modification of PL procedures (Teller, et. al., 1974). Essentially, the observer's role is modified, which also alters the method of determining acuity. Instead of recording the amount and duration of fixation by looking at the corneal reflection, the observer records whether the striped pattern stimulus is on the right or left side based upon observation of all of the infant's responses. The requirements for the infant are the same in PL procedures; to be awake, alert and able to differentially fixate upon stimuli in the visual field.

Another modification of PL is the operant preferential looking (OPL). In this procedure, the child (6-24 months old) is first trained to look toward the right or left side of a grey screen in which a black-white square wave grating pattern is activated. Each time the infant looks toward the side with the activated pattern, s/he is reinforced by a lighted toy adjacent to the screen. After training, the test phase begins. Different stripe widths are presented to the right or left side on a random basis. The observer judges the location of the grating stimulus based on the infant's responses. Reinforcement is given in the test phase only when the infant's responses are clear enough for the observer to correctly judge the location. The requirements are essentially the same as for FPL procedures except that the child is conditioned to make the initial fixation responses. See Mayer and Dobson (1980) for more information.

In all of the preferential looking procedures reliable observation is crucial and may require considerable training. The major difficulties in administering these tests to severely handicapped students lie in obtaining and maintaining attention and cooperation for a test session and in observing consistent responses in the context of brief assessment sessions which are often in novel environments. In addition, special stimulus cards and equipment are required.

Far Point acuity measures include the STYCAR (Sheridan, 1973) graded balls test, successive discrimination, and simultaneous discrimination procedures. Only the STYCAR graded balls test will be discussed below. The other procedures will be discussed along with the errorless discrimination procedures in the next section.

The STYCAR graded balls vision test was designed for young children and handicapped children. There are two sub tests for visual acuity: the rolling balls test which measures acuity for moving objects, and the static balls test which measures acuity for static objects. The procedure for the rolling balls test consists of rolling 10 white plastic balls ranging from 1/8" to 2½" in diameter across a black carpet 1 ft. wide x 2½' long, placed 20 feet from the child. The examiner signals to get the child's attention and rolls the balls in size order from the largest to the smallest, varying the speed, distance of the roll, and side from which it originates. The child's usual response is to watch each ball until it stops rolling. The smallest size ball which elicits this response gives an indication of the far point acuity of the child with Snellen equivalents recently established by standardization on 75 five to seven year old children with normal vision.

The second section of the test involves the ability of the child to fixate on static white balls at a distance. In this test, the balls are mounted on rigid black poles that are presented from behind a screen. The examiner sits behind the screen, gets the child's attention, presents the mounted balls from one side of the screen or the other, and observes the child's movements through a slit in the screen. The appearance, disappearance, and reappearance of the balls causes the child to fixate and then refixate the ball as it moves. Three or more presentations are made for each size ball, and acuity estimates are again based on the smallest size ball that will elicit a response. The requirements for the child for both tests include the ability to fixate on a small white ball, the ability to look to left or right of midline, the ability to track a moving object and the ability to maintain attention to a game-like situation.

The determination of visual acuity thresholds for most severely handicapped and/or deaf-blind students is difficult (or impossible) using the procedures described above. This is due to a combination of factors including absent or limited receptive (and expressive) language repertoires, attention deficits, and poor discrimination skills. Members of this population often demonstrate extreme difficulty in mastering discriminations between colors, shapes, and common objects, and consequently cannot participate in assessments which require visual discrimination skills.

As an alternative to these assessments, recent data suggest that use of errorless discrimination training strategies may be an effective and successful procedure for obtaining acuity thresholds with difficult to test or untestable persons (Macht, 1971; Newsom and Simon, 1977; Spellman and Cress, 1980). Errorless stimulus control strategies lead to the formation of a discrimination with few or no responses (errors) made to the incorrect stimulus (cf. Terrace, 1963; Stoddard and Sidman, 1967).

Errorless discrimination training begins with a discrimination response that is already in the student's repertoire, e.g., the response is under stimulus control of an initial set of stimulus items. Stimulus control is then shifted from this initial set of stimuli to new stimuli through gradual change in the stimulus items. Gradual and systematic changes in stimulus items is referred to as fading (see Goetz, Baldwin, Gee & Sailor, 1981). Dimensions along which stimulu have been systematically faded include intensity or brightness (Stoddard & Sidman, 1967), size (Schreibman, 1975), and duration of the time interval between presentation of the controlling and non-controlling stimuli in a procedure known as time delay (Touchette, 1971).

As an example, consider the major training steps in the Parsons Visual Acuity program (Spellman and Cress, 1980). First the student participates in a series of pretests to evaluate the student's receptive language skills, picture preferences for the stimuli used in training, and position biases when presented with a three item display.

For a student who does not have the receptive language skills needed to point to a particular picture upon request (e.g., "point to <u>cake</u>"), training begins at step 1. During this phase, a particular picture (e.g., cake) is selected as the training item. The student is required to point to (or match) the cake picture on a display panel when no other distractor pictures are present.

Once this initial discrimination is established through use of differential reinforcement, the distractor items are gradually faded in using an intensity fade. On the first fading card, the distractor items (a bird and a hand) appear only very faintly. With each successive fading card, the distractor items grow darker and darker, until by the final step of the fading process, all three pictures are of equal intensity.

Throughout training, the position of the target picture is randomly located at left, right or center of the display. Thus, by the final training step, the student has learned to always select the cake, regardless of its location and regardless of the other distractor items that are present. Because the intensity of the distractor items is faded in gradually, the probability of an error (incorrect response) is reduced (see Spellman and Cress, 1980 for a complete description of the training program.)

Once the student has learned to always select the target picture when all three pictures are of equal intensity, the size of the pictures is systematically reduced to meet the specifications for Snellen acuity ratios (e.g., 20/200, 20/100, 20/70, etc.). The student's visual acuity is determined by consistent patterns of successful responding at one acuity level followed by consistent failure at the next lowest acuity level. Spellman and Cress (1980) have reported extensive development and validation data on the Parsons Visual Acuity program. The project used this program with several students and found it to be an effective and reliable procedure for obtaining near point acuity measures.

Macht (1971) and Newsom and Simon (1977) have also reported the use of fading procedures to accomplish far point visual acuity testing. Macht uses a special apparatus that consists of a rotating wheel and a response lever in conjunction with an intensity fading procedure to establish a discrimination between a forward facing and reversed Snellen E. Macht's procedure appears effective but requires special construction of the stimulus wheel and response lever and is therefore somewhat limited in its classroom applications.

Newsom & Simon (1977) presented an errorless training procedure in which stimulus control was transferred from a choice between a blank white card and a card with a downward oriented Snellen E to a choice between a card with a downward oriented Snellen E and a card with a leftward oriented Snellen E. The correct card throughout training was a downward pointing E, and an intensity fade was used to gradually change the blank white card to a card containing a leftward oriented E. Once the discrimination between the downward and leftward E was mastered, the E's were systematically reduced in size to obtain far point acuity ratios.

Eight of eleven psychotic children were successfully trained and tested using this procedure, but the three lowest functioning students failed to meet criterion in the final program steps. The authors speculated that this failure was due to stimulus overselectivity (Koegel, Lovaas, Rehm and Schreibman, 1971); Schreibman, 1975). Stimulus overselectivity refers to the inability of some autistic and retarded students to attend to more than one stimulus dimension at a time. Thus, throughout the Newsom and Simon fading program, intensity was the relevant dimension along which the stimuli were faded. However, once the intensity fading was complete, the student suddenly had to attend to orientation, or directionality, of the E, in order to successfully

complete the testing phase. Overselective students may not have been capable of making this shift from one stimulus dimension (intensity) to another (orientation).

To eliminate the need for transferring stimulus control across two different dimensions of a training stimulus, the following program was developed for subjective measurement of far point visual acuity. This program is based upon procedures described by Newsom and Simon, but uses directionality of the E as the relevant dimension along which the stimulus cards are faded. Thus the initial step of the program requires a discrimination between a downward pointing E and a blank card. The leftward pointing E is faded onto the blank card not along the dimension of intensity, but along the dimension of orientation, so that the leftward E "grows" in small increments from a single vertical stripe to a full leftward E in a series of 16 cards.

To date, this program has been successfully completed with five severely and/or multiply handicapped students. Validation data are reported in detail in Baldwin and Goetz (Reference Note 1).

DISCRIMINATION AND TESTING FOR FAR POINT VISUAL ACUITY

This is a two part program consisting of discrimination training and testing to measure far point visual acuity in difficult to test students. It is based on the Newsom and Simon study of 1977 which taught a discrimination between a vertical Snellen E card and a horizontal Snellen E card placed twenty feet from the subject. Once the discrimination was established, subjective visual acuity was measured by varying the size of the E's on the cards.

The major difference between this program and the Newsom and Simon (1977) one is the type of stimulus fade used. Newsom and Simon used an intensity fade-in of the left ward pointing E. As a result, by the 16th step the subject had to make a stimulus shift from intensity to orientation as the major feature. Several of their subjects failed to make this shift and were subsequently untestable. Therefore, orientation of the E was selected as the major feature throughout the discrimination training. The cards are therefore, designed to fade in the left-ward pointing E in a way that emphasizes its directionality (see Fig.10).

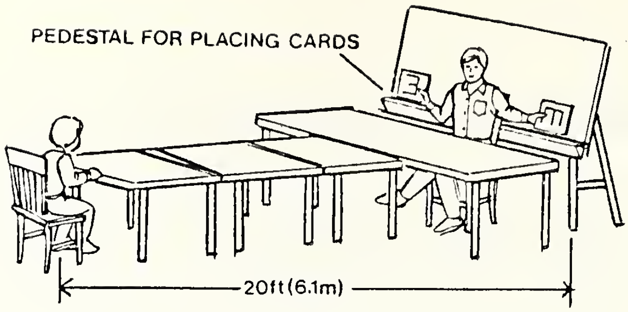
Materials:

The discrimination training cards are made of white poster board 16 cm. square. The Snellen E's are drawn with black india ink and the cards are covered with clear contact paper. In the set of 17 are one blank card, 15 cards with the E faded toward the left in increments of 1 cm., and 1 card with a left ward pointing black Snellen E (159.6 x 31.9 mm segments) which also serves as the first test card in the acuity testing phase (see Fig.12). A card with a downward pointing Snellen E (159.6 x 31.9 mm segments) serves as the dicriminitive stimulus card throughout the program.

The test cards are the same size and made with the same materials as the discrimination cards. A set of test cards consists of eight pairs, each pair having Snellen E's of the same size but different orientation (e.g., one downward pointing, the other left ward pointing, see Fig.12). The sizes of the test letters were determined by measuring the widths of segments and spaces from an existing Snellen E chart (a formula to use for calculating these widths can be found in Newsom and Simon, 1977). The sizes of the E's on the cards represent acuity ratios of 20/200, 20/100, 20/70, 20/50, 20/40, 20/30, 20/20, and 20/15.

Setting:

The training area is set up with three tables placed end to end. A fourth smaller table is placed crosswise at the end of the tables,nearest the blackboard, and a chair is placed at the other end of the tables twenty feet from the blackboard (or screen). The teacher sits at the smaller table within easy reach of the blackboard and the child sits at the far end of the long tables. Thus, the tables form a natural central barrier forcing the child to approach the card only from one side or the other.



General Procedures: (See Task Analysis outlines for more detail).

The goal of the training procedure is to teach the student to select the downward pointing E. This response can then be used to assess the subjective Far Point Acuity of the student. The teacher places a pair of stimulus cards (training or testing depending on the appropriate program phase) on the chalkboard tray of the blackboard. Each card is thus in the center of either the left or the right passageway formed by the control tables. The child is given a signal to look at the cards and then is directed through verbal and/or sign cue to come and get the correct card. She/he has to stand up and walk down the passageway to the card. If the child chooses the correct passageway and retrieves the downward pointing E card, she/he receives positive reinforcement. If the child chooses the wrong passageway, she/he is told "no, wrong side, sit down".

Baseline phase:

The child is given a chance to make the discrimination between the downward pointing and the leftward pointing E cards (card pair #17) following the general procedures described above. If the child is able to make the discrimination (5 consecutive correct responses), it may be possible to skip the training phase and move directly into the testing phase. If the child is unable to make the discrimination begin with the first step of training.

Training phase:

The child is trained to select the downward pointing E from the two stimulus cards presented. The leftward E is gradually faded in on the other stimulus card in a way that emphasizes its directionality (see sample training cards) until the child is clearly choosing the downward E when it is paired with a leftward E of the same dimensions. The criteria for each fading step is outlined in detail in the task analysis on the following pages. After the 1st card (e.g., the discrimination between downward E and a blank card which has a criteria of 2 correct responses) the child moves to a new card pair with each correct response. Thus, the program uses an errorless training procedure. After an incorrect response, the right/left placement of the cards remain the same until a correct response is given. This is done to prevent the child from adopting a preference for one side and being correct 50% of the time without having learned the discrimination. Then the child must get 4 more correct

responses on the same card pair when the random left/right sequence is resumed before moving to the next card pair and continuing an errorless progression. In order to exit from the training phase and enter the test phase, the child must make 5 consecutive correct responses on the last card (the discrimination between a downward E and a leftward E of the same dimension.)

Test phase:

The child's subjective far point acuity is assessed using the test set of cards. With each pair of cards in the test set, the size of the E's get smaller, representing specific acuity ratios. The child's ability and inability to continue to choose the downward pointing E from the leftward pointing E as the figures get smaller gives an indication of his/her subjective far point acuity. Three criterion runs of three consecutive correct responses at one acuity ratio followed by an incorrect response at the next smaller ratio on two different test days will be required before considering the acuity ratio achieved the child's subjective far point acuity.

Data:

A data sheet shows the randomization of the position of the cards and provides spaces to record the correct/incorrect responses of the child. The column under "card" is for the number of the card pair being used (e.g., in training, it will be #1 through #17; in testing it will be the acuity ratio of the E figured on the card, 20/200 through 20/15). The top portion of the data sheet is filled in to provide an example of the correct movement through the cards for discrimination training; the bottom portion is filled in to provide an example of the correct movement through the cards for testing (see the task analysis outlines for further clarification, if necessary).

Graphs:

Training: A graph is kept of the student's progress through the discrimination training showing the percent of stimulus cards passed within each session. This percentage is calculated by dividing the number of the highest card passed within the session by the total number of cards in the set (e.g., 11/17 = 65%).

Testing: The test graphs show the child's progress through the various size Snellen E's. Three successful criterion runs (consisting of 3 consecutive correct responses at one ratio followed by an incorrect response at the next smaller ratio) are required at a specific size before the corresponding acuity ratio is considered the child's subjective biocular distance acuity. Sample performance graphs from a project student follow the task analysis.

Program modifications:

If a child has a severe loss in acuity, he/she may be unable to go through the discrimination training at a distance of twenty feet. Failure to meet criteria on the first training step may indicate a need to start the child sitting very close to the cards and then slowly moving him/her back. Once the optimal distance has been found for the first training step, the child can be taken through the discrimination training and subsequent testing at that distance. An eye specialist can help determine the acuity ratios for the distance used.

The far point acuity program can also be adapted for non-ambulatory students by utilizing a different response mode (e.g., movement of other parts of body or activation of switches to indicate card choice, etc.). The project did not obtain validation data on such adaptations.

FAR POINT ACUITY DATA SHEET

SAMPLE TRAINING DATA

NAME [illegible] DATE [illegible] SESSION# [illegible]

TRIAL	CARD	SIDE	RESPONSE
1.	1	L	+
2.	1	R	+
3.	2	R	+
4.	3	L	+
5.	4	L	– – +
6.	4	L	+
7.	4	R	+
8.	4	R	+
9.	4	R	+
10.	5	L	+

Intensity 5
Percentage 29%

SAMPLE TEST DATA

NAME Tony DATE 10/12/8[illegible] SESSION# 12

TRIAL	CARD	SIDE	RESPONSE
1.	20/200	R	+
2.	20/150	R	+
3.	20/70	L	+
4.	20/50	L	–
5.	20/70	L	+
6.	20/70	R	+
7.	20/70	R	+
8.	20/50	R	+
9.	20/50	L	+
10.	20/50	R	+

TASK ANALYSIS: FAR POINT ACUITY DISCRIMINATION TRAINING

Objective: When two Snellen E cards (one pointing down and the other pointing to the left) are placed at a distance of 20 feet from the student she/he will choose the downward pointing E, five consecutive times in ten trials within a 20 minute session.

A. Baseline.

Teacher	Student
1. Show downward pointing E card to child; say/sign "this is the card," then put card #17 on one side of the chalkboard and the discriminative stimulus card (downward pointing E) on the other side (following random order sequence. Direct child to "look at cards" then "come get the card". If the student consistently chooses the correct E, training may not be required prior to to testing.	1. Student must look, get up from chair, walk down a passage toward card and touch or pick up card.

B. Training

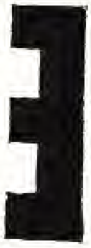
Teacher	Student
1. Present first pair of cards #1, the blank card paired with the discriminative stimulus card, the downward pointing E by placing one on each side of the chalkboard. Reinforce if correct. Say/sign "wrong one, sit down" if incorrect. Student must make 2 consecutive correct responses before moving to step 2.	1. Student must look at the cards on the blackboard tray, walk down a passage toward correct card, and touch or pick up the card.
2-16. Present pair of cards 2-16 each paired with the discriminative stimulus card, the downward pointing E . Follow procedures in step 1 (above) except that the student can move ahead after each correct response. Once error is made, student stays at same step until 5 consecutive correct responses. Also, the same left/right placement of the cards is maintained until a correct response is made, then random order sequence is continued.	2-16. Same as above.

(continued)

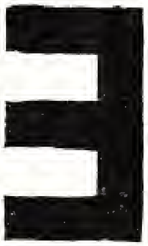
B. Training (continued)

Teacher	Student
17. Present pair of cards (card #17 paired with the discriminative stimulus card, the downward pointing E). Follow previous procedure except the student must get 5 consecutive correct responses to complete the program and begin the testing phase. If the student fails to make 5 consecutive correct responses out of 15 trials on any discrimination card, re-start entire program at step 1. After 3 program restarts, consider modifications such as decrease in distance from the cards, etc. If the child is still unable to meet criteria, the practicality and appropriateness of the program for that student should be re-evaluated.	17. Same as above.

TRAINING CARDS



CARD PAIR #6



CARD PAIR #10

CARD PAIR #17

Figure 10

Sample performance data from one of five students who completed the Far Point Acuity program are found in Figure 11. Tony needed two program re-starts to reach criteria. Although he progressed rapidly through the program the first time, he was unable to meet the exit criteria on the nineteenth session. Again, he progressed rapidly through the program until summer break after session 21. Upon return from the break he immediately moved to card 16 but failed to meet criteria and the program was re-run. This time he was able to meet the exit criteria in session 28 (and again in session 29 which was done specifically for reliability measurement). The total training time was less than 10 hours (28 sessions approx. 20 minutes each).

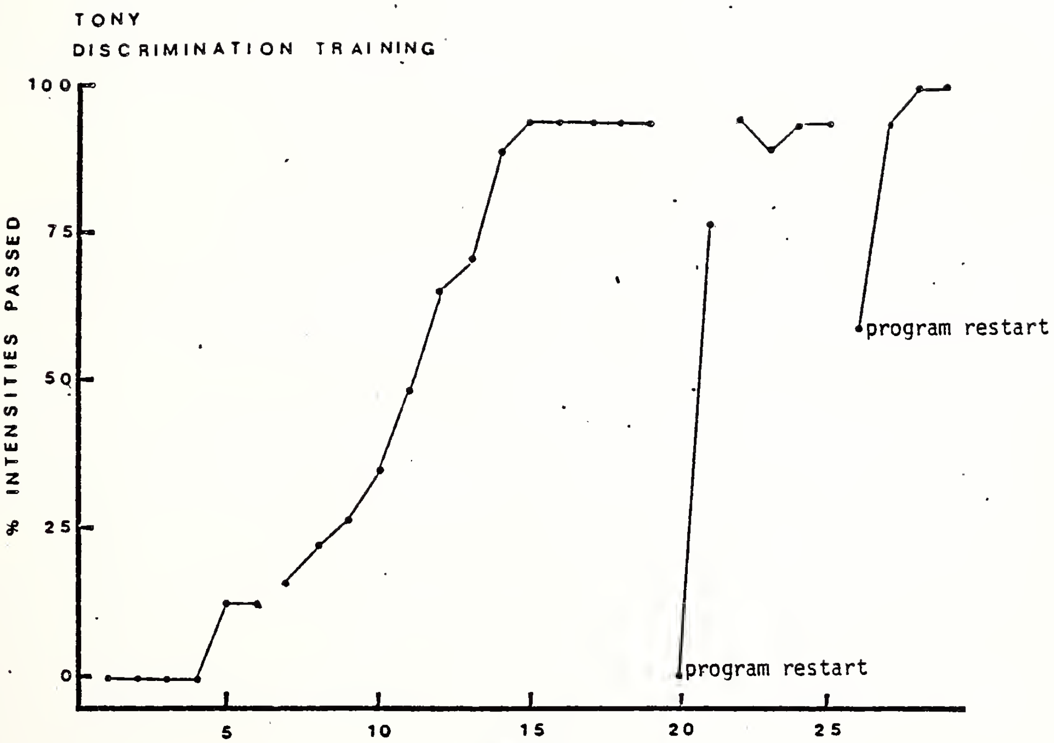

TONY
DISCRIMINATION TRAINING
% INTENSITIES PASSED
100
75
50
25
0
program restart
program restart
5
10
15
20
25
SESSIONS

FIGURE 11

TASK ANALYSIS: FAR POINT ACUITY ASSESSMENT

Objective:

When two Snellen E cards (one pointing down and the other pointing to the left) are placed at a distance of 20 feet from the student, she/he will continue to choose the downward pointing E at successively smaller sizes until a clear alternation pattern emerges of a criterion run (3 consecutive correct at one size followed by immediate failure at the next smaller size). When three such criterion runs are achieved at one size on 2 different test days, the corresponding acuity ratio will be considered the child's subjective binocular far point acuity.

Assessment:

Teacher	Student
1. Present training cards #17. If 5 consecutive correct responses, begin testing with Snellen test cards.	1. Student must look, get up from chair, walk down a passage toward card and touch or pick up card.
2. Present the pairs of test cards with progressively smaller E's until the first error occurs.	2. Same as above.
3. Present the pair of cards that are the next larger acuity ratio than those on which the error occurred. If the child gets 3 consecutive correct, again present the smaller cards. With each error move to the next larger size. With three consecutive correct responses move to smaller size cards.	3. Same as above.
4. Continue to test until there is a clear alternation pattern of criterion runs (3 consecutive correct at one size followed by failure at the next smaller size). If this pattern is repeated three times, the size at which the three successful criterion runs occurred will be considered the child's "subjective binocular distance acuity."	4. Same as above.

TEST CARDS

ACUITY RATIO 20/70

ACUITY RATIO 20/40

ACUITY RATIO 20/20

Figure 12

In Figure 13, are samples of test data from Tony taken on two separate occassions. The dots connected by horizontal lines represent correct trials; the dots that are unconnected represent incorrect trials; and the vertical lines represent movement to smaller or larger size E cards. The two test graphs would suggest that Tony's far point acuity is at least 20/70 and possibly better.

In previous examinations by an eye specialist, no subjective measures of far point acuity could be made. Tony is a 7 year old severely handicapped boy with a profound bilateral sensorineural hearing loss. He has accomodated esotropia and wears glasses for correction.

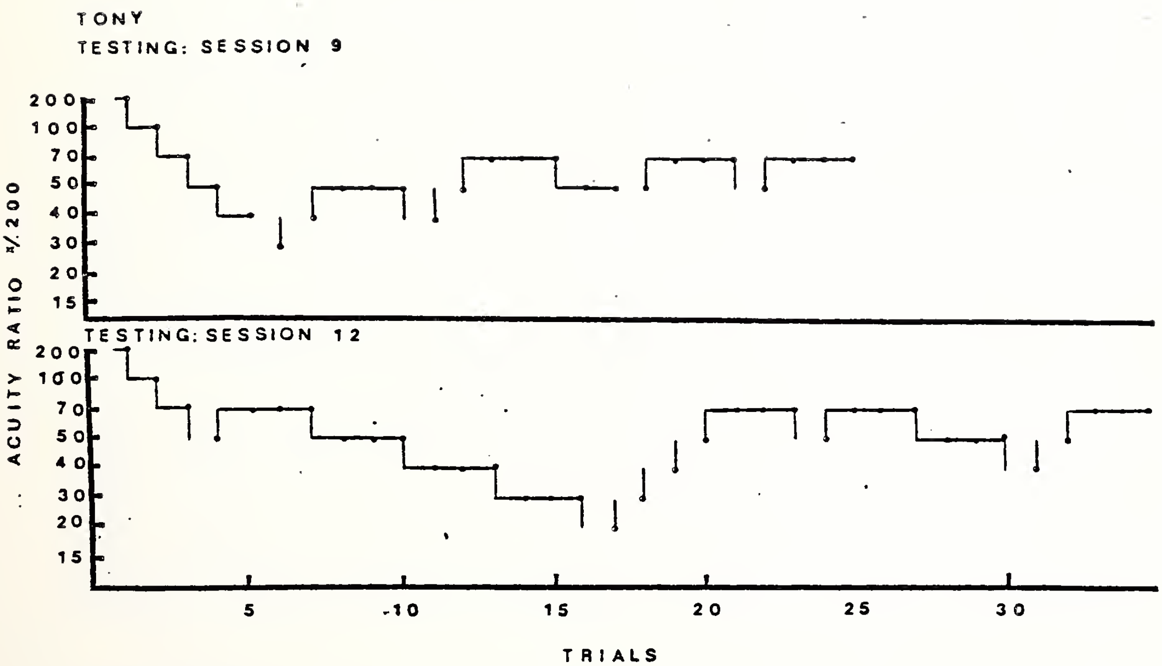

TONY
TESTING: SESSION 9
TESTING: SESSION 12
ACUITY RATIO x/200
200
100
70
50
40
30
20
15
5
10
15
20
25
30
TRIALS

FIGURE 13

SECTION VI: DECISION MODEL

Clearly, not all severely handicapped deaf/blind students will require every vision assessment presented in the previous sections. Some students will have extensive data from an eye specialist documenting both medical problems and functional vision use. Other students will have incomplete data, while still others will have no information at all.

Figure 14 presents a decision model for use in administering Sections I-IV of the manual. The decision model was developed for use by teachers who are fimiliar with both the procedures and possible implications of each of the assessments. It is intended as a general guide to avoid unnecessary assessment efforts. However, if there is question as to a student's overall visual status, it may be helpful to administer the entire manual.

The column at the left indicates possible entry points into the assessment. The first step is always to consult recent medical data, or, if needed, to obtain an opthalmological exam. On the basis of these data, and based on educational evaluation of the student, several entry points are possible.

If a student's overall visual status is unknown or ambiguous (Box A), for example, if it is uncertain whether both eyes have any functional vision, assessment should begin with Section I. In contrast, if previous data indicate functional vision in one or both eyes, but no further detailed information (Boxes B or C), assessment may begin at Section II. A student with congenital cataracts which have been surgically removed, for example, may be fitted with corrective glasses, but information concerning peripheral field vision and near and far acuity may nevertheless be lacking.

Box D indicates a student whose visual status is clearly specified and documented. In this instance, vision assessments may be unnecessary and emphasis will turn toward instructional programs specifically tailored to the student's visual needs. Box E indicates a frequent occurrence with severely handicapped students. While functional vision is apparent, both from medical and educational sources, and specific deficits are documented, visual acuity is unspecified. These students' primary assessment need may therefore be determination of visual acuity ratios.

The boxes on the right half of Figure 14 represent progress through the assessments. While Section I may be skipped under circumstances described above, if a student demonstrates visual behaviors in Section II (ocular coordination), it is always recommended that Sections III and IV also be carried out. These sections constitute an initial short term screening which can be accomplished in a reasonably short time span (1 to 2 hours total if the teacher is familiar with the procedures).

These data should then be shared with an eye specialist. Because the acuity assessments are long term, programmatic assessments, they are not included as part of the short term screening.

The summary form at the back of the manual was intended to provide teachers with a one page format for reporting their data to an eye specialist. This form should be used to report data, and not to interpret data. If a blink reflex was observed only once out of three trials, record and share this information. If no responses were observed in the upper half of the right peripheral field, record and share this information. An eye specialist can use your data to facilitate his own interpretation and to make recommendations for instruction.

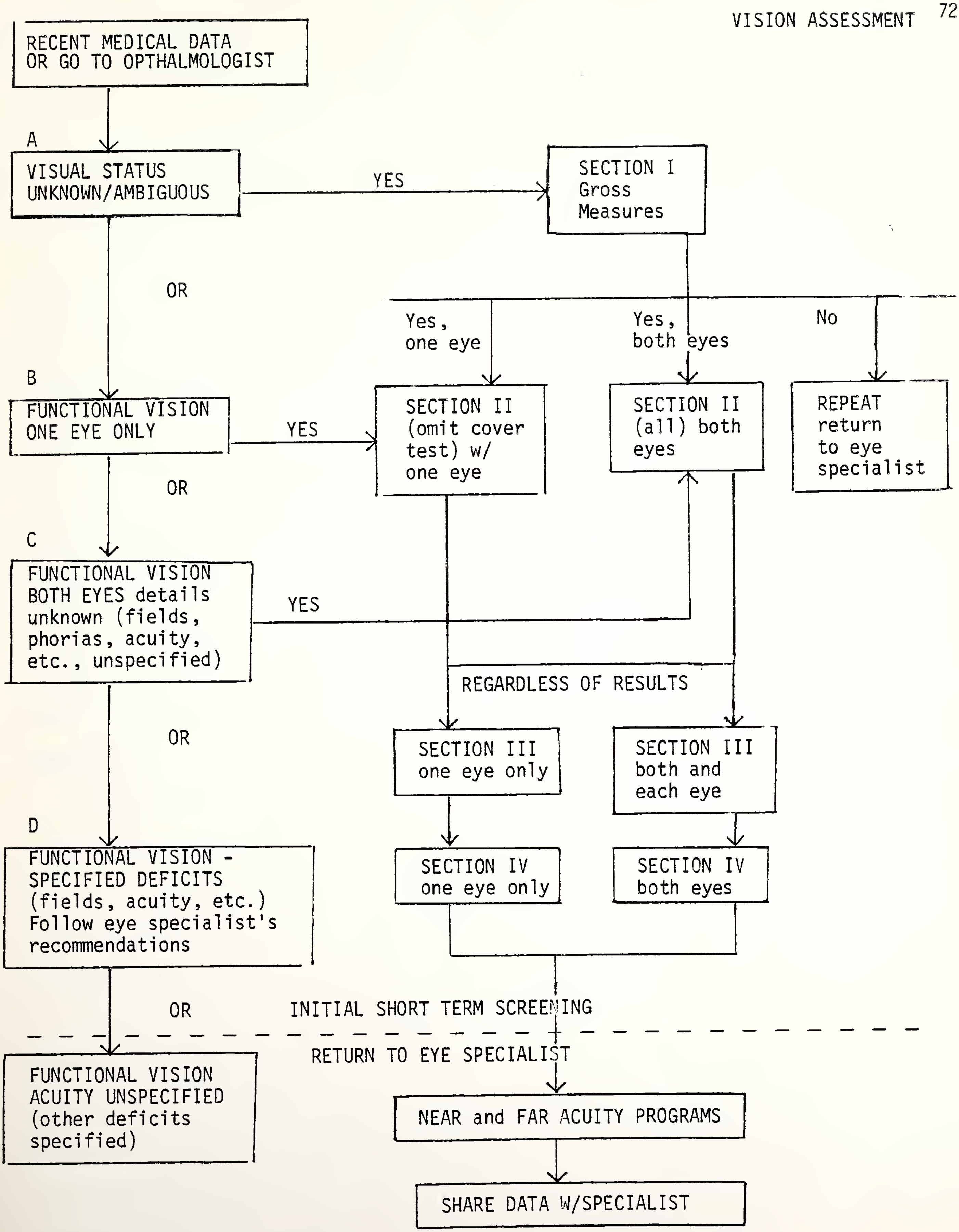

RECENT MEDICAL DATA
OR GO TO OPTHALMOLOGIST
A
VISUAL STATUS
UNKNOWN/AMBIGUOUS
YES
SECTION I
Gross
Measures
OR
Yes,
one eye
Yes,
both eyes
No
B
FUNCTIONAL VISION
ONE EYE ONLY
YES
SECTION II
(omit cover
test) w/
one eye
SECTION II
(all) both
eyes
REPEAT
return
to eye
specialist
OR
C
FUNCTIONAL VISION
BOTH EYES details
unknown (fields,
phorias, acuity,
etc., unspecified)
YES
REGARDLESS OF RESULTS
OR
SECTION III
one eye only
SECTION III
both and
each eye
D
FUNCTIONAL VISION -
SPECIFIED DEFICITS
(fields, acuity, etc.)
Follow eye specialist's
recommendations
SECTION IV
one eye only
SECTION IV
both eyes
OR
INITIAL SHORT TERM SCREENING
RETURN TO EYE SPECIALIST
FUNCTIONAL VISION
ACUITY UNSPECIFIED
(other deficits
specified)
NEAR and FAR ACUITY PROGRAMS
SHARE DATA W/SPECIALIST

Figure 14

SECTION VII: FUNCTIONAL VISION PROGRAMMING

The system of instructional programming for functional vision use presented in this manual is based upon 2½ years of field testing in a classroom serving 12 severely multiply handicapped deaf blind students, and upon preliminary experimental data documenting the establishment of generalized visual fixation skills using instructional procedures described below (Goetz, Gee, and Sailor, Ref. Note 1). While several of the guidelines for practice presented here are supported by available data, it should be emphasized that conclusive experimental evidence documenting the effectiveness of these gudielines is not yet available. Teachers should therefore regard these guidelines as general recommendations. Be prepared to modify these strategies as needed on the basis of observation and experience derived from applying the guidelines in your own classroom.

INTRODUCTION

A major premise underlying the programming approach of this manual is that many visual behaviors are operant in nature. This premise is based upon several sources of data. Schroeder and Holland (1968) first demonstrated the operant nature of ocular scanning and refixating behaviors working with non-handicapped adults. Subsequently, Craig and Holland (1970) demonstrated the operant nature of sustained visual attending in classrooms of deaf children and Maier and Hogg (1974) increased both the duration and frequency of visual fixation in severly retarded, hyperactive students using positive reinforcment procedures. More recently, experimental data gathered at the project (Goetz, Gee, and Sailor, Ref. Note 2) also demonstrate the successful application of specific operant training procedures (use of a systematic error correction procedure in conjunction with positive

reinforcement) to establishing generalized visual fixation during visual motor tasks in severly multiply handicapped students. Utley (1981) has also demonstrated experimentially the operant nature of fixation in severely multiply handicapped infants. Numerous other authors and educators have also regarded certain visual skills as responsive to systematic instruction based upon operant methods (Robinson and Robinson, 1978; Scheuerman, Baumgart, Sipsma, and Brown, 1976).

In light of evidence such as the above, the program strategy recommended in this manual is based upon careful application of operant principles in the context of data based instruction (cf. Snell, 1978; Haring, Liberty and White, 1980). Teaching visual behaviors is presumed to involve more than just visual stimulation, or the provision of opportunities to receive sensory input through the visual mode. Instead, effective teaching strategies for visual behaviors entail arranging the instructional environment so that use of vision results in specific desirable and functional consequences for the student. Thus, visual skills are not taught in isolation, but rather in the context of other skill learning. The student always has a functional and reinforcing reason to perform the visual response, and this consequence is contingent upon the visual behavior.

The format developed by the project for teaching functional visual behavior involves six specific steps listed below:

1. <u>Determine the specific target visual skill(s) the student needs to learn</u> (e.g., fixation, tracking, scanning, binocular coordination, etc.).

2. <u>Determine functional skills in other curricular areas (e.g., self help, motor, leisure, social, etc.) which require use of the target visual skill and select a skill to pair with the visual skill</u> (e.g., fixate on spoon before receiving food; track and retrieve desired toy, etc.).

3. Determine when during performance of the paired functional skill it is crucial to use the visual skill and define this as the critical visual moment (e.g., when stacking glasses, student will fixate on glasses from the time one glass touches the other until insertion is complete).

4. Develop a teaching strategy and error correction procedure for the visual behavior (e.g., physically prompting the response and systematically fading the prompt; augmenting verbal prompt to "look" with a penlight or flashlight shining on the object, etc.).

5. Develop a task analysis and teaching strategy for the paired functional skill (e.g., a three step analysis using backward chaining to teach hanging cups on hooks).

6. Teach the visual behavior and the paired functional skill together within the same instructional session or context, each skill according to its own strategy, and monitor performance data.

The following sections address in greater detail how to carry out each of the above steps.

SELECTING A VISUAL SKILL

Selection of appropriate vision objectives for severely, multiply handicapped students remains one of the most difficult aspects of effective vision programming in the classroom. First, great variability exists among these students in terms of cognitive and physical functioning. Secondly, a variety of different visual impairments, including cataracts, glaucoma, optic atrophy, strabismus and numerous other impairments may be associated with retardation and cerebral palsy (cf. Wolf and Anderson, 1973; Donlon, 1976). Determining the appropriate visual behaviors to teach a student thus becomes a highly individualized student specific process that is dependent upon numerous factors and sources of information.

One source of information is the transdisciplinary assessment team, including information from the physical and occupational therapists concerning positioning and handling techniques which can enchance the student's visual functioning. Robinson and Robinson (1978) note, for example, that visual fixation is more readily achieved if the student is positioned to have his head stable and in midline. Also potentially helpful, if available, is information from the vision resource teacher, particularly concerning any specialized visual assessments he is able to perform with the student and concerning enviornmental adaptations and visual aids that appear to enchance the student's visual functioning. A vision resource teacher may also be especially helpful in explaining available information from an optometrist or opthalmologist to the teacher. Finally, as part of the transdisciplinary assessment information, results obtained from specific vision assessment scales such as the current manual or the Functional Vision Inventory for the Multiply and Severely Handicapped (Langley, 1980) many also be helpful in determining what visual skills a student demonstrates and what skills the student lacks.

A second major source of information is determining appropriate vision objectives for a student is discussion with the student's eye specialist (opthalmologist or optometrist). If you are able to, accompany your student on a visit to the eye specialist, bringing along the assessment date summary sheet from this manual and any other transdisciplinary assessment information. Observe the specialist carrying out his assessments and also show him your own data. The set of questions listed below may be helpful in organizing the information from the specialist. These questions can be asked in reference to both your own assessment data and in reference to the tests the specialist performs in the office:

VISUAL BEHAVIOR	POSSIBLE RESPONSES
orient to presence of a visual stimulus	head turn, gaze shift, brief fixation (less than 1 second)
fixation	bifoveal or monofoveal corneal light reflection
accommodative convergence	continuous fixation as object approaches until object moves within four inches of nose
shifting gaze between two points	fixate on one object, then on second object
peripheral vision	shift of gaze to find object located on periphery of visual field
tracking	smooth eye movement to follow object, both eyes aligned
scanning	smooth, systematic scan of visual display

TABLE 2

1. What behavior does the assessment measure and what is the underlying visual function? (e.g., The cover test measures deviations in the uncovered eye indicative of coordinated vision in the two eyes.)

2. What is the underlying physiological basis of the test: (e.g., Decreased acuity may be caused by optic atrophy, a condition in which the optic nerve degenerates due to inadequate blood supply.)

3. Can the visual behavior be changed either through an instructional program (e.g., increasing diagonal and vertical tracking skills through a functional tracking program) or through prostheses (e.g., an eye patch for strabismus or glasses to correct refractive errors)?

4. If the student's visual status cannot be changed through instruction or prostheses what environmental adaptations are recommended to facilitate best use of vision? (e.g., A low vision student may benefit from high contrast materials.)

The aim of this assessment process is to obtain an understanding of what the student's current visual status is, and an understanding of what visual behaviors the student lacks. Table 2 below presents a brief list of different visual responses and possible measures of these responses that the teacher may want to consider in determining appropriate vision objectives.

In deciding which visual behaviors to teach, several resources may be helpful. Langley (1980) provides an overview of the normal development of visual functioning, outlining the emergence of fixation, accomodation, and tracking behaviors and the development of visual acuity. Robinson and Robinson (1978) present a detailed discussion of the development of fixation and tracking behavior and early visual motor coordination. Both of these resources may be helpful in selecting target visual skills and skill sequences considered in conjunction with the individual student's current visual status.

Once vision objectives have been selected for a student, a last step, if possible, is to briefly confirm the appropriateness of the objective with the vision specialist. A quick summary of the assessment data, along with an explanation of your teaching goal and how you plan to achieve it, may enable the specialist to provide important insights or guidelines concerning fatigue, physiological factors, follow up objectives, etc.

SELECTING A PAIRED SKILL CONTEXT

Once a student's vision objectives have been identified, the second step is to idenify other functional skills which require use of that visual skill. Training the visual skill is paired with training other functional skills, so that visual behaviors are learned in appropriate and natural contexts.

In selecting a paired skill context, the teacher's goal is to identify learning tasks and situations in which the visual skill is functional and necessary, but in which the student nevertheless does not demonstrate the visual behavior. Consider the visual skill of active fixation. When is active fixation a functional necessity? The answer will vary for each student, dependent in part upon the student's cognitive and motoric functioning and dependent upon other skills the student is currently learning. One student might fixate in order to reach and grasp an item such as a cup or communication board switch. Another student might need to learn to fixate in order to facilitate putting his toothbrush in a toothbrush rack or completing assembly of a circuit board. For still another student with limited motor abilities, a functional context for learning fixation might involve fixation on a lighted spoon or cup before opening his mouth. This action could designate readiness to practice chewing or drinking.

Table 3 provides several examples of vision skills and possible paired functional skills and contexts in which to teach the visual skills. Selecting an appropriate paired skill context requires careful consideration of all of the factors discussed below.

TABLE 3

VISION SKILL	POSSIBLE FUNCTIONAL PAIRED SKILLS
active fixation (look and then . . . . .) OR gaze shift (shift gaze, fixate, and then . . .) OR peripheral gaze (shift to object on periphery, fixate, and then . . . . . .)	1. reach and grasp small items such as fingerfood, spoon, cup, toothbrush, hairbrush, switch on electric wheel chair 2. designate readiness to eat or drink by opening mouth after fixation on spoon or cup 3. receive receptive gestures, signs, pictures or symbols 4. activate age-appropriate play items such as puzzles, coins in piggy bank, radio and T.V. switches 5. perform fine motor skills such as stacking cups or plates, hanging wash-cloth on hook, putting clothes into laundry bag 6. engage in gross motor skills such as crawling or walking to observed location, sitting down on designated chair
track (visually follow action and then . . . . .)	1. retrieve or activate age appropriate toy such as ball, rolling crayon, "slinky" toy, balloons, bubbles, model airplane 2. approach or initiate communication with peer, parent, teacher after s/he has moved through the environment
scan (scan visual display and then . . . . .)	1. make three-choice discrimination in context of receptive/expressive communication tasks using age appropriate, functional vocabulary items 2. discriminate a speaker who called student's name and walk to that speaker 3. discriminate chair, work station, placemat, toothbrush holder labeled with student's name from a group of similar objects and engage in appropriate action with the discriminated object 4. perform specific visual discrimination tasks related to community/independent living skills such as survival vocabulary, picture cookbooks

1) Student's general level of functioning. Determination of a paired skill to teach with the visual behavior you are teaching will depend in part upon the student's general functioning level. Some authors (cf. Langley and DuBose, 1976; Funderberg, 1978) have stressed that visual functioning is closely intertwined with cognitive functioning, and the purposeful use of vision is dependent upon underlying conceptual and perceptual development. However, the general lack of valid and reliable assessment tools for measureing cognitive functioning in this population makes practical application of this guideline difficult.

Rather than trying to determine a formal cognitive level and then basing your vision and paired skill objectives on that, this manual emphasizes instead an analysis of the other skills and objectives a student is learning in different curricular areas including gross and fine motor, communication, self help, leisure, social, and vocational domains. If these objectives have been generated on the basis of assessment information in each area, the nature of the objectives should suggest numerous paired skills and instructional contexts that are appropriate for teaching the specific visual skill. These possible paired skills should then each be further evaluated in light of other criteria discussed below.

2) Functionality of the paired skill/context. Functional skills are skills which increase a student's level of independent functioning in his home, school, and community environments. Selecting paired skills that are functional means selecting skills which will increase independence and then teaching these skills with materials and contexts which are age-appropriate and natural to the student's interaction with the environment. Thus, it is functional to use a pail and shovel in a sand box to teach visual attention

to complex visual motor tasks such as pouring, if the student is of pre-school age. If the student is an adolescent, however, sand box play skills are not age-appropriate and will do little to further independence. Instead, visual attention to the act of pouring can be made more functional if the paired skill involves pouring laundry into a washing machine or pouring cake mix into a measuring cup.

The use of functional skill content across curricular domains has been discussed by Brown, Branston, Hamre-Nietupski, Pumpian, Certo and Gruenewald (1980) and by Holvoet, Guess, Mulligan and Brown (1980). A crucial rationale for the use of functional contexts in teaching visual behaviors is the failure of many severely handicapped students to generalize skills from the training environment to other environments (cf. Stokes and Baer, 1977). Thus, if visual skills are trained in isolated and artificial contexts, they may well have to be retrained before they are used purposefully in natural contexts. Pairing visual skills with functional skills can therefore hopefully result in considerable savings in training time.

Use of age appropriate materials and contexts does not mean, however, that you must overlook developmental data concerning preferences for different types of visual stimuli at different stages of visual development. Familiarity with developmental sequences of pattern preferences (e.g., Fantz, 1973; Kagan, 1973) may suggest guidelines in the selection of age appropriate and functional materials. For example, a student who is to fixate on an object and then reach toward the object (but not yet grasp it) may learn this skill in the functional context of reaching toward a comb or hairbrush. Data on color and pattern preference further suggests that red and orange are among the first colors for which normal infants shown preference. Thus, use of a

bright red comb within this training context may facilitate acquisiton of the visual behavior without compromising a functional approach to instruction.

3) Necessity of the visual response in the skill context. Closely related to the functionality of the paired skill is whether or not the visual skill is truly necessary to successful performance of the paired skill. Does the student really need to use the visual behavior to accomplish the paired skill (or to complete the skill more quickly) or is the demand for the visual behavior in that context an artificial one?

For example, teaching visual scanning might be paired with a three choice discrimination task in which the student must match a sock to a sock and then fold the pair of socks. The student must scan the items if he is to make a correct matching response. In contrast, it is not necessary for a student to scan the lunch table to find his plate of food if the plate is always placed directly in front of the student. Careful evaluation of the need for the visual behavior in a skill context can help the teacher to avoid purposeless demands to "look", "watch", etc., when in fact the skill context does not really require looking (see also motivational factors discussed below). Demanding a visual behavior when it is not genuinely needed for task completion may be aversive to many students.

4) Motivational Factors Related to Use of the Visual Skill. The process of selecting a visual skill and a paired skill or context for teaching that skill should also involve careful examination of whether the student ever performs the visual skill in any context. For example, a student may not exhibit the visual skill of tracking when the teacher says "look" and moves an interesting toy across the student's line of vision. However, when a desirable piece of food falls from the table to the floor, the student may readily track

the item as it falls, presumably because he is more highly motivated to keep the food in view than to keep a toy in view.

If the student already does perform the target visual skill in specific situations, the teacher may want to consider if it is necessary to teach the skill at all. If the student does use the skill at times when it is a functional necessity, instruction may be unneeded. If, however, the student uses the skill inconsistently -- he uses it in some highly motivating contexts, but does not use it in other functional contexts, these other functional contexts may provide natural opportunities for teaching the student to use the visual skill.

The goal of selecting a paired skill context in teaching any visual behavior is to teach the student a purposeful reason for making that visual response. Whatever the visual skill is that the student is learning, selection of a functional skill context should teach the student that use of his vision facilitates performance of other age-appropriate, functional, and motivating skills.

IDENTIFYING THE CRITICAL MOMENT.

As the teacher begins to design a vision training program, he or she must decide on a criteria which will designate correct or incorrect visual responses. This will, for the most part, depend on the choice of the paired functional skill and the student's functioning level. The decision involves identifying the critical moment at which the student must be fixating, tracking, scanning, etc. in order to accomplish the paired skill. When and for how long is the visual behavior required in order to correctly perform the task?

For example, when must the student be fixating in order to stack one glass into another? The critical moment might be stated as follows: the student must be fixating from the time one glass touches the other glass to when insertion is completed. For putting a coin into a piggy bank, the critical moment to fixate might be designated as from the time the coin is within 1 inch of the slot to completion of insertion.

The critical moment for fixation while hanging cups on hooks might be to fixate on the hook from when the cup is within an inch of the hook until the handle is slipped over the hook. When reaching for and grasping an item, the critical moment for fixation might be that the student must fixate on the item from when he begins to reach until he touches the item.

Looking further at the last example, remember that this criteria is for fixation and that a separate criteria and program strategy operate the paired skill. If the student is on Step 2 of a reach and grasp program, for example, it might require the following: After the student has been assisted to reach and grasp the spoon, he will be able to hold grasp for 5 seconds while being assisted to carry it to his mouth. Visual fixation should still be demanded according to the above criteria. In other words, the student would be responding correctly on the visual behavior at this point if he fixated on the spoon until the teacher had finished assisting him to reach and touch it.

Another consideration in choosing a critical moment is the student's general physical ability and functioning level. If the student in the sample above has severe athetosis and it takes some effort and time to first place his hand on the table, the critical moment might need to be stated differently. Instead it might read: The student must look at the spoon from the time his hand is placed on the table to when he touches and begins to grasp the spoon. As a further example, consider the visual behavior of fixation during a task involving controlled release of grasp. For a severely spastic student who as yet has no independent feeding skills, fixation on his hand may be required for a two second duration as the student is prompted to begin releasing a bowl into the sink by placing his hand on the edge of the sink. Fixation is not required, however, for the duration of the time needed to complete the release. In contrast, a student who has numerous independent self help skills may be required to fixate upon his toothbrush from the time he takes it out of his mouth until it is accurately released into a cup.

Little empirical data is available to assist a teacher in designating critical moments at which vision appears necessary for successful task completion. One suggestion which might assist a teacher is to physically go through the paired skill activity and note the times at which vision is needed for task completion, keeping in mind the student's functioning level as you do so. Establish when and from what starting to ending points the visual behavior is needed to carry out the task, and then consider the speed and proficiency with which the student actually does the paired skill. Based on this information, define a specific critical moment during which you will measure the visual behavior for the individual student. Because visual behaviors are often difficult ot observe and measure accurately, it is critical to determine a visual response that is clearly defined and readily observable.

TEACHING STRAGEGIES FOR VISUAL BEHAVIORS

After the teacher has designed a vision objective, picked a paired skill, and designtated the critical moment, the next step is to ensure that the student actually performs the desired visual behavior. The teaching strategies for establishing visual behaviors developed by the project include two phases: 1) selection of prompting technique and 2) use of a continuous correction procedure.

Prompting Techniques. The prompting techniques used by the project can be divided into four categories: 1) use of physical and tactile prompts; 2) use of auditory cues; 3) use of augmentative visual cues; and 4) use of "time out" techniques.

Physical and tactile prompts refer to strategies which first involve actually assisting the student to fixate, track, or scan by moving his head, tapping a cheek, taking the student's hand and placing it where the student should be looking, etc. Physical assistance is then faded until the student can do the visual behavior without prompting, or as stated in the objective. For example, the teacher may use a physical prompt or direct the student's face at an item to fixate on and use. The teacher must also specify how that prompt will be systematically faded.

Auditory cues involve the use of speech or other sound cues different from any initial verbal instructions used in the final objective. As an example, consider a student who is being taught to fixate while putting a cup on a hook. The final vision objective might be that he fixate while putting cups on hooks without any prompt or cue other than the instruction, "Put the cup on the hook." Any added verbal cues such as, "look" or "keep looking" would be considered part of the training strategy, and would ultimately need to be faded away.

Other auditory cues include: tapping the item while pointing to it, tapping the item itself (such as a cup or a table), or calling the student's name. Auditory cues can easily be paired with other visual and tactile cues. For example, to get the student above to look at the hooks, the teacher might first point to the hook and then tap it as the student maintains fixation.

Any added visual stimulus which helps to call attention to the item the student should fixate, track, scan, etc. is considered an augmentative visual cue. Pointing to the item or shining a flashlight on it are two common visual cues. As with other prompting technieues, specific strategies must be planned for ultimately fading out the light cue.

Augmentative visual cues should be differentiated from visual aids. Some students will benefit from the use of high contrast materials and low vision aids. These aids would remain stable throughout the program. Vision itinerant or resource teachers are a good source of information on ways to adapt materials for low vision students which enchance contrast or size, such as using a dark brown cup on a yellow table to improve it discriminability for a low vision student.

All of the prompting techniques described above operate by adding an additional cue to the instructional situation - a cue which is intended to prompt or facilitate performance of the visual behavior. As with any prompting strategy, systematic procedures for fading away these prompts must also be planned. Prompts can be faded using a time delay strategy (Touchette, 1971) or an intensity fading procedure in which the intensity of the added auditory or visual prompt is gradually diminished.

A fourth set of prompting strategies are "time out" techniques. "Time out" techniques are particularly useful for students who are visually inattentive. These strategies refer to various ways of stopping the instructional activity

when the student does not perform the visual behavior. One method is to simply remove all the task materials from the setting whenever the student looks away from the task. Materials are returned only when the student re-establishes visual attention to the desk top or work surface. Consider as an example a student who is working on fixating while performing the fine skill motor skill of stacking cups. She may begin to look and then look away while groping for the place to stack the cup. At that point the teacher using this technique would pull the stack of cups away. The student would most likely either stop because of failure, or look to see where the cups were. The teacher could then replace the materials and try again.

Another way this type of technique can be implemented is by simply ceasing assistance. If the teacher is helping a student on a fine motor task such as putting batteries in a hearing aid and fixation is required from the time the battery is within 1 inch of the hearing aid until it is inserted (critical moment), the teacher might use the following technique. When the student does not look during the critical moment, the teacher would cease assistance on the fine motor task. By dropping the student's hand(s) and ceasing assistance, the task could not continue. As soon as the student resumed the visual behavior, assistance would also resume.

Use of a specific prompting procedure is only one component of establishing visual behaviors. In addition, a systematic error correction procedure is also recommended. If the teacher decided to use an auditory cue, such as tapping the object, to estabish fixation, and the student still fails to fixate on the object, the error correction procedure described below may be appropriate.

Error Correction Procedure. The error correction procedure this project found to be effective for teaching visual behaviors was called a continuous correction procedure (Utley, 1979). When a student responds incorrectly, the

teacher marks a (-), and then follows whatever strategy is designated, such as tapping the object, flashing a penlight, etc. The teacher then repeats the same trial giving the student the same amount of cues and assistance as before and waits for a response. If the student responds correctly this time, the teacher marks a number 1 next to the (-) to show that the initial response was incorrect and it took one more time to achieve a correct response (-1). If the student again responds incorrectly, the teacher corrects again in the same way. The teacher keeps representing the trial with the designated assistance and prompting until a correct response is achieved. When the correct response is made, the teacher records the number of times he repeated the trail next to the (-). The scores look like this: (-5); (-3); (-1); etc. If the student responds correctly, on the very first presentation of the trial, he or she receives a (+).

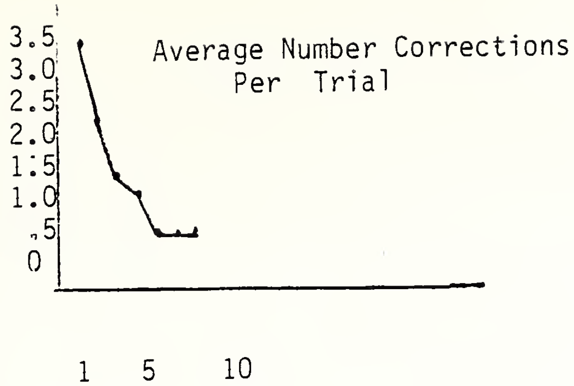
The advantage to using this system with visual behaviors is that the student always has to make a correct visual response before going on to the next behavior. In addition to using a paired skill which by its very nature requires the visual behavior, the teacher using this correction porcedure does not let the student try to do the paired skill without first exhibiting the desired visual behavior.

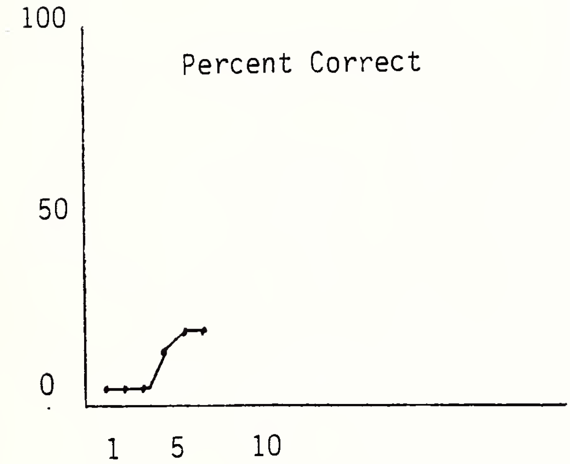
For example, a student working on scanning paired with a 3-choice discrimination task might receive the initial cue, "Look and find the same," while the teacher gives him a sample object The student might begin to scan but look away before placing down the item. The teacher would stop the student and correct him using whatever strategy (e.g.auditory cue, physical prompt, etc.) was designed and start the trial again. The student would not be allowed to make the discrimination response until he correctly scanned. The student might have a score of (-3) for the visual behavior, and

when he finally scanned, might receive a score of (+) for the discrimination trial.

This procedure requires care in structuring the task analysis and stategies in a way which will ensure the likelihood of success. The teacher must be reasonably sure that the student <u>can</u> perform the visual behavior, or the repeated trials may be highly aversive. The data from the trials will assist the teacher in making decisions about the correction procedure.

The data are recorded in two ways. One graph depicts the percent of correct responses on the very first presentation of the trial (+), for example, 3 correct responses out of 10 tirals is 30%. The other graph depicts the average number of times the trial had to be repeated during that session. The number is computed by adding up the number of re-presentations and dividing it by the total number of trials per session. In the same example above, there were 7 trials out of 10 in which an incorrect response was given on the first try. If those scores were as follows: (-3), (-5), (-2), (-1), (- 3), (-2), the total number of re-presentations is 17. Computing the average number of corrections, the score would be 17 corrections/10 trials = 1.7 as the average. Scores will vary depending on the number of corrections. Sample graphs below show how the scores might look:





As you can see, the average number of corrections will go down as the percent correct goes up. Many times the correction graph shows progress when the percentage graph does not. If the student has just begun a program and she rarely gets the response correct on the first trial, the data may show improvement in the average number of corrections. It may decrease from 6 to 1.5 in the first few weeks giving the teacher the information that the response is becoming less difficult, even though correct responses on the first trial have not yet improved.

When using this correction procedure the reward for responding correctly on the very first try should be differentiated from the reward for a correct response after the correction procedure. The system of reinforcement should give a greater reward for immediate success than success after repeated trials.

This procedure can be defined as a negative reinforcement procedure because the student is not allowed to go on with the task until the correct visual behavior is given. It is not a punishment procedure, but since it does involve negative reinforcement, the teacher should be aware of any necessary clearance procedures the school required before the procedures are implemented.

TEACHING THE PAIRED SKILL

The paired skill a student is working on may range from a complex fine motor task to a visual discrimination task. Whatever the skill, it requires an instructional program distinct from the program developed for the visual skill. Thus, the paired skill will have its own task analysis and teaching stragegy. If the student is learning to track an item (visual skill) and then reach and grasp it (paired skill), for example, the reach and grasp skill may follow a six step task analysis using backward chaining, while the visual tracking of the object follows its own instructional program as outlined in the preceding sections.

MONITORING THE DATA

Unfortunately, little data is available to assist teachers in evaluating the relationship between the acquisition of the visual skill and the acquisition of the paired skill. The student may rapidly acquire the visual skill, for instance, while acquiring only the first or second step of the task analysis for the paired skill. Similarly, the student may fail to acquire the visual skill, while nevertheless making rapid progress on the paired skill. Because there are no clear guidelines, we recommend that each skill (the visual skill and the paired skill) be charted on its own graph and that the teacher use the same decision making rules concerning changing or continuing a program for these programs as he uses for other instructional programs in the classroom (cf. Haring, White, and Liberty, 1981 for disucssion of data-based decision making in the classroom).

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APPENDIX A

DATA SHEETS

Student: ______________________ Disabilities: ______________________

D.O.B.: ______________________ ______________________

Date: ______________________ Etiology: ______________________

SUMMARY FORM

1. Previous ophthalmological information: ______________________

____

____

2. Current medications: ______________________

____

3. <u>Reflexive responses</u>

   Blink reflex observed?

   Blink rate: attentive ______ per minute inattentive ______ per minute

   Pupillary: Do both pupils constrict to light? ______

   If not, describe: ______________________

   ____

   Consensual response observed in: Left eye _____ Right eye _____

   Equal constriction rate? ______ If not, describe: ______________

   ____

4. <u>Ocular Coordination</u>

   Bifoveal fixation? _____ Monofoveal fixation? L _____ R _____

   Deviation present during: Cover/uncover ______ Convergence ______

   Describe: ______________________

   ____

   ____

5. <u>Peripheral Fields</u>

   R eye

   L eye

   Shade the area in which student did not respond reliably to the two penlight test.

6. <u>Acuity Thresholds</u>

   Near: Right ________ Left ________ Both ________

   Far: Right ________ Left ________ Both ________

   Measure used: ______________________

7. Comments: ______________________

____

NAME: ______________________ DATE: ________________

GENERAL OBSERVATIONS

Setting: Classroom, cafeteria, school yard, hallways.

Materials: No special materials

Procedures:

1. If you are confident answering the questions below on the basis of your familiarity with the student, do so. If you are uncertain, observe the student for 3-5 minutes in at least 3 of the above settings.
2. Briefly describe the student's behavior in response to the questions below.

Does the student move purposefully toward objects and people in his/her immediate environment, e.g. approaches another student and reaches for toy;moves toward watering fountain to indicate thirst, etc.?

Does the student consistently avoid or move away from people or objects in his environment, e.g. runs away when approached by peer; turns away when presented with undesired materials, etc.?

Does the student avoid obstacles when moving in his environment, e.g., stops at closed door, navigates around chairs and tables, etc.?

Describe any other behaviors you feel are relevant to the student's visual functioning, e.g., consistent head tilt or turn, persistent squinting or rubbing eyes, brings objects very close to eyes for examination, etc.

NAME: ____________________ DATE: ________________

Blink Reflex - Procedure 1

Setting: Classroom, normal light levels

Materials: The teacher can use her open hand or a small soundless toy.

Procedures:

Position your hand or object 12" in front of student's face at eye level.

Quickly move your hand/object toward the student's eyes, stopping suddenly 2" from the eyes. The movement must be fast and well controlled to obtain an accurate response. Wait an interval of an least one minute between responses.

Response:

The response you are looking for is a blink. The student may blink rapidly several times in immediate succession, or may blink only once. Some students may show a delayed blink. In this instance, the blink may occur up to one full second after presentation of the stimulus.

Recording the data:

Perform 1-2 preliminary trials. Then perform 3 trials and record the data below.

Trial	1	2	3
Response			

Total: __________

Comments:

NAME:________________________ DATE:________________

Blink Reflex - Procedure 2

Setting: Classroom, normal light levels

Materials: The teacher can use her open hand or a small soundless toy.

Procedures:

Occlude the right eye.

Position your hand or an object 12" in front of the student's left eye at eye level.

Quickly move your hand/object toward the student's eye, stopping 2" in front of the eye, and back out again 3-5 times in rapid succession.

Immediately move your hand/object toward the student's eye again, but move your hand only 1-2". The student will blink again, despite the fact that the stimulus is at a safe distance. He will have "learned" to blink.

Repeat procedure a total of 3 times for the left eye.

Occlude left eye and repeat 3 times for the right eye.

Repeat 3 times for both eyes.

Response:

You are looking for a blink after the last presentation of the object, when you have moved it only 1-2". The student may blink once, several time rapidly, or may show a delayed blink up to 1" after presentation of the stimulus.

Recording the data:

Perform 1-2 preliminary trials. Then perform and record 3 trials for each eye and 3 trials for both eyes together.

Right Eye			Left Eye			Both Eyes		
Trial 1	Trial 2	Trial 3	Trial 1	Trial 2	Trial 3	Trial 1	Trial 2	Trial 3

Total R: ________ Total L: ________ Total Both: ________

Comments:

NAME: ____________________ DATE: ____________________

Blink Reflex - Procedure 3

Setting: Classroom, normal light levels

Materials: Teacher's hand, penlight

Procedures:

The student should be in a supine position with a small amount of flexion at the neck. The hips and knees should be well flexed. Kneel or sit at the student's head.

Position the penlight so it shines into the student's face at a distance of 12-13" (33 cm) at midline eye level.

Hold your other hand flat and move it between the light and the student's face, observing for a blink reflex as you do so.

Response:

The blink reflex as described in the two previous tests.

Recording the data:

Perform 1-2 preliminary trials. Then perform 3 trials and record the data below.

Trial	1	2	3
Response			

Total: ____________________

Comments:

NAME: ______________________________ DATE: ______________________

ASSESSMENT OF BLINK RATE

The student who fails to demonstrate a blink reflex should be observed closely for two 2 minute periods of time, one period when the student is on task, the other when the student is at rest. The number of blinks during each 2 minute period should be recorded with "hash" marks on the individual recording form in the spaces provided.

The "normal" rate of blinking ranges from 2-28 times per minute. During periods of concentration the rate may go as low as 2 per minute. The rate may rise to as high as 28 per minute during conversation. A total absence of blinking or an extremely low (e.g., less than 2 blinks per minute) is a cause for concern. The absence (or very low rate) of blinking indicates that the function of the eye may become impaired. Blinking is a maintenance mechanism which distributes tears to remove dust dust and lubricates the cornea. Distribution of tears prevents drying of the cornea and protects the eye from infection. An absence of blinking requires medical attention to prevent drying of the cornea.

Record your observations below:

Student on task	[ ]	(total # of blinks) / 2 minutes)	= ______	blinks per minute
Student at rest	[ ]	(total # of blinks) / (2 minutes)	= ______	blinks per minute

NAME: ____________________ DATE: ____________________

Pupillary Constriction - Procedure for Each Eye Alone

<u>Setting</u>: This procedure should be conducted in subdued lighting conditions. <u>This is very important!</u> The student should be <u>facing</u> toward a wall that has no windows or areas which differ greatly in color or illumination. These procedures should not be done in a totally dark room but should be done in a part of the classroom (or in a separate room) with the lights off. The subdued lighting will make pupil constriction more dramatic.

<u>Materials</u>: Penlight, clear plastic ruler or optistick

<u>Procedures</u>:

Position the student in the area of subdued light and wait 2-3 minutes for the student's eyes to adapt to the lower light level.

Without using the penlight, observe the student's pupils and record the following:

Are both pupils equal size? _____ yes _____ no

If unequal, which is larger? _____ right _____ left

Draw within the iris diagrams the actual size and shape of the student's pupil. These iris diagrams are drawn to scale; hold the ruler 3-4 inches in front of the student's eyes with your thumb and second and third fingers as shown. Place the tip of your index finger against the temple of the student to stabilize the ruler. Estimate the diameter of each pupil in milimeters.

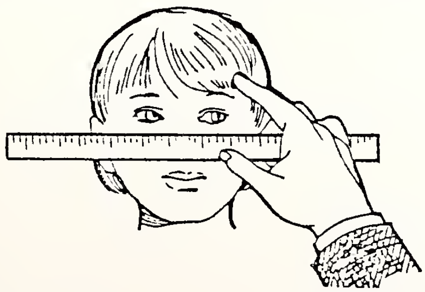


Figure 2.

Right eye __________ Left eye __________

Fill in pupils on the diagrams below and be sure to include any irregularity of shape or size.

right eye

left eye

(Note: The student's <u>right</u> eye will be on your <u>left</u> and vice versa.)

With the penlight turned off, position it 4-6" in front of student's right eye.

Turn the light on and shine it straight into the student's eye, observing the pupil for approximately 2 to 3 seconds before turning off the light. Since the response occurs very rapidly, there is no need to continue shining the light after several seconds.

Wait at least one minute between trials. Perform the procedure 3 times for the right eye and 3 times for the left eye.

Response:

You are looking for constriction or shrinking of the pupil. This response occurs very rapidly. If the student blinks, turns his head away, etc., you may fail to observe it. Record only trials in which you have observed the pupil continuously for the first 2-3 seconds after the light is turned on.

Recording the data:

Perform 1-2 preliminary trials. Then perform 3 trials for each eye.

Right eye

Trial	1	2	3

Total ______

Left eye

Trial	1	2	3

Total ______

NAME: ____________________ DATE: __________

Pupillary Constriction: Procedure for both eyes together

Setting: Position the child so the stimulus can be presented quickly. This may mean moving the student close to the window where the shades are drawn, or to a table where a lamp is positioned. This procedure may require 2 adults, one to activate the light source (turn on the lamp, quickly raise the shade, or flick on overhead lights) and the other adult to observe both eyes for simultaneous pupil constriction.

Materials: Large table lamp, clip on lamp with a bare bulb, light from windows, or overhead lights can be used. The source of illumination must reach both eyes simultaneously and be of equal brightness in both eyes.

Procedures:

Position the student and yourself so you are able to see directly into the student's eyes.

Activate (or cue your assistant to activate) the large light stimulus.

Quickly look from one eye to the other and observe the student's pupils for two to three seconds before deactivating the light source.

Wait 1 minute between trials and repeat the procedure for a total of 3 trials.

Response:

You are looking at the rate of constriction, i.e., is the speed of constriction the same in both eyes? As with the previous procedure, the response occurs within the first seconds after presentation of the stimulus.

Recording the data:

Did pupils constrict at the same rate?

Trial 1 _____ Trial 2 _____ Trial 3 _____

If pupil constriction rate was unequal, which pupil constricted faster?

Left _____ Right _____

NAME:______________________________ DATE:________________

Pupillary Consensual Response

Setting: Same as above. Make sure the lighting condition in the classroom is the same as it was during the earlier assessment. The student should be facing away from the bright light sources in the classroom.

Materials: Penlight

Procedure:

Position the unlit penlight so it will shine directly into the student's right eye at a distance of 4-6 inches.

Look directly into the student's left eye and turn on the light.

Watch for pupillary constriction in the eye not being stimulated. Watch for two or three seconds and then turn off the light.

Wait at least 1 minute between trials and follow the order of presentation in the chart shown below.

Response:

You are looking for constriction in the eye not being directly stimulated.

Recording the data:

Perform 1-2 preliminary trials, then follow the order below and score:

Trial	Light to:	Observe:	Response
1	right eye	left eye	
2	left eye	right eye	
3	left eye	right eye	
4	right eye	left eye	
5	left eye	right eye	
6	right eye	left eye	

NAME:______________________________ DATE:____________

Bifoveal Fixation

Setting: Classroom or a dark room. The dark room has the advantage of making the lighted stimulus more dramatically visible to the student, thereby increasing the probability that the student will look at the light stimulus for 3-5 seconds.

Materials: Penlight, plastic pop bead (optional)

Procedure:

Position the unlit penlight 12-13" (33 cm) from the student's face and level with the tip of the student's nose.

Be certain your own face is directly centered behind the penlight. Your eyes should be directly opposite the student's eyes, neither above, below, nor to the right or left.

Turn on the light and observe the position of the light in each cornea. If the student's eyes are wandering or he is looking elsewhere, you may flick the light on and off a few times to obtain his attention. Do not wave the penlight repeatedly back and forth across the student's line of vision in an attempt to center it in the pupils of both eyes. You are looking for an active fixation response on the part of the student. If the student simply fails to attend to the light, do not score the trial and re-present it.

Wait at least 1 minute between trials and repeat for a total of 3 times.

Response:

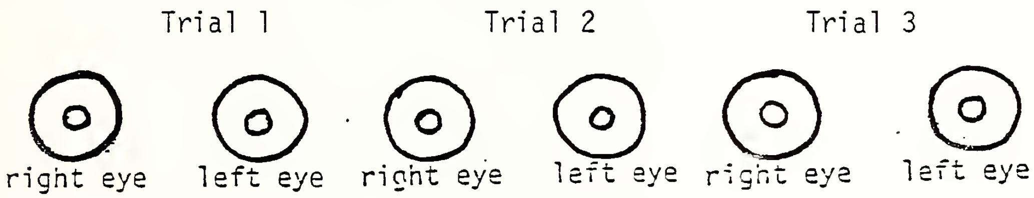
You are looking for the reflection of the lighted stimulus in the same relative location in each eye. If the student is fixating on the light this location will be in the center of both pupils. If one of the student's eyes rolls inward or outward, you will observe the light in the center of the pupil of the eye that is not turned in or out, but the light will be reflected elsewhere (e.g., on the iris) of the turned eye.

A "false" correct response may be observed if the student is in fact gaging or fixating on a point beyond the light. To verify the student is actually actively fixating on the light, move it slowly one inch to

the right or left. If the student tracks the light and it remains in the center of each pupil as the eyes move to the right or left, this is an indication that bifoveal fixation is present. Failure to track may indicate a lack of bifoveal fixation or a variety of medical conditions and should be reported to the eye specialist.

Recording the data:

Perform 1-2 preliminary trials. Perform 3 trials and draw the location of the reflection on each trial in the diagram below:



NAME: ______________________________ DATE: ____________________

Cover Test

Setting: Classroom or subdued lighting levels (optional).

Materials: Occluder or index card, penlight or visually interesting toy no larger than 3 x 4".

Procedure:

With one hand, hold the visual stimulus 12-13" (33 cm) in front of the student, at midline and level with the tip of his nose and watch for fixation.

With the other hand, hold the occluder in your lap for 3-4 seconds.

While the student is fixating on the stimulus, quickly lift the occluder and position it 2-3" in front of the student's right eye. The occluder must block the right eye's view of the stimulus, as shown below, for 2-3 seconds in an attempt to break fusion of the covered eye. However, the stimulus itself remains clearly in the line of vision of the student's left eye.

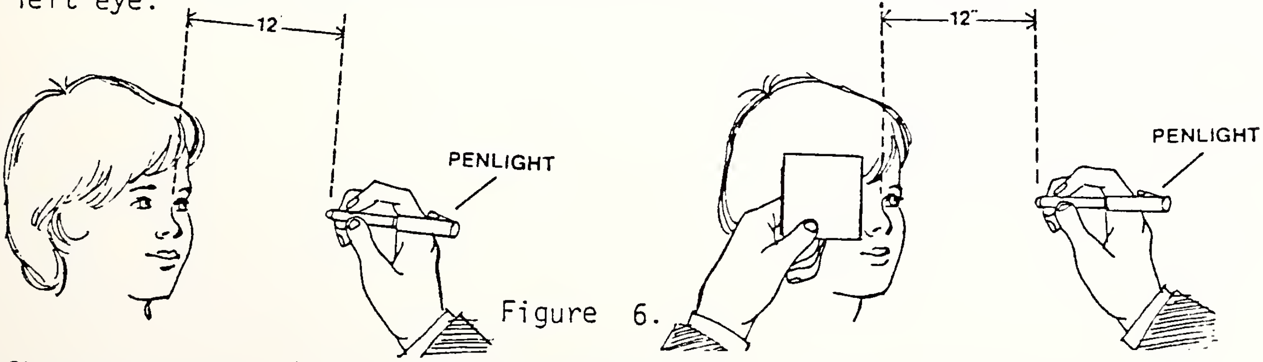


Figure 6.

Observe the left (unoccluded) eye immediately after occluding the right eye.

Wait one minute between trials and complete 6 trials following the order below.

Response:

You are watching for any shifting movement in the unoccluded eye, regardless of direction. The shift occurs rapidly after the other eye is occluded.

Recording the data:

Perform 1-2 preliminary trials. Perform 6 trials following the data sheet below:

Trial	Occlude	Observe	Shift?	Direction
1	R	L		
2	L	R		
3	L	R		
4	R	L		
5	L	R		
6	R	L		

Comments:

NAME:________________________ DATE:________________

Accomodative Convergence

Setting: Classroom

Materials: Penlight inserted in pop bead (optional), ruler

Procedure:

Present the lighted object at midline 16-18" from the tip of the student's nose. You must obtain fixation on the object (you may flick the light on and off a few times to get the student's attention) in order to do this assessment. Use whatever fixation response you obtained in the previous assessment as bifoveal fixation is not a prerequisite.

Move the lighted object toward the tip of the student's nose. It should take 3 seconds to move the object a distance of 12-14".

Observe the student's eyes during movement of the object. When convergence breaks, as described below, record the distance between the object and the student's nose.

Response:

You are watching for a number of responses. Normal convergence will involve both eyes turning inward to remain fixated on the object. When the object is 3-4" from the eyes, convergence breaks, in that the eyes can no longer form a single image. When convergence is broken, the student may 1) blink and refixate or 2) one or both eyes may roll up, down, or sideways. However, many persons will continue to converge on an object until it touches the nose, despite the fact that they are seeing a double image when they do this.

You may thus observe a number of responses. The student may hold his head in midline and one or both eyes may roll up, down, or sideways when convergence is broken. Or, the student may turn his head to watch the object with one eye as it approaches.

Recording the data:

Perform 1-2 preliminary trials. Perform three trials and record the data on the following page. If deviation occurs when fixation is broken, indicate which eye and the direction of the deviation. If convergence is not observed, indicate no response.

Trial Number:	1	2	3
Distance at which convergence is broken			
Deviation observed	L R	L R	L R

If the student's head deviates to either side, record the direction of the head turn and the preferred eye below for each trial.

	 head turn to left R eye is preferred			 head turn to right L eye is preferred		
Trial						

If you have observed convergence, repeat the procedure one more time and watch for pupillary constriction during convergence. Was constriction observed? ______________________

Comments:

NAME: ______________________________ DATE: __________

Peripheral Field - Two Penlight Test

Setting: Dark room.

Materials:

Two penlights of equal size and intensity with silent switches; eye patch.

Procedure:

Position yourself directly in front of the student at eye level. With both penlights off, position one light 12-13" from the student's face at nose level. Position the second light 10-12" above the student's nose at midline, with the penlight parallel to the floor.

Turn on the central penlight and obtain fixation.

After no more than 2-3 seconds of fixation, turn off the central penlight while simultaneously turning on the second penlight. Watch for gaze shift.

Repeat, following the numbered positions on the data sheet below.

Response:

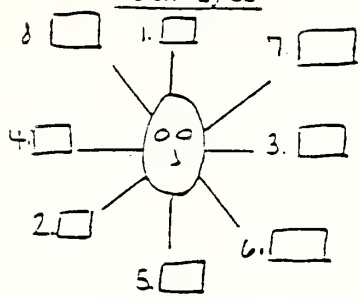
You are looking for a shift of gaze from the central to the peripheral light. In addition, when you assess the eyes together, observe whether or not the shift of gaze is symmetrical - do both eyes shift simultaneously and in the same direction? All responses should occur within 3 seconds.

Recording the data:

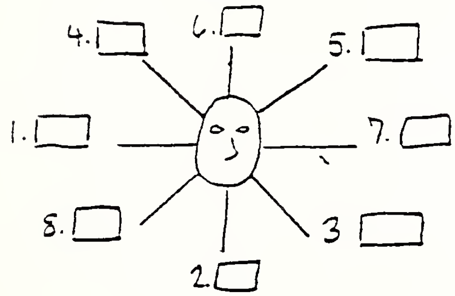
Perform 1-2 preliminary trials. Conduct the assessment on both eyes, following the order of the numbered positions on the diagram below. Then patch the left eye and assess the right eye and vice versa. Then complete the assessment once more on both eyes together.

Two Penlight Test - continued

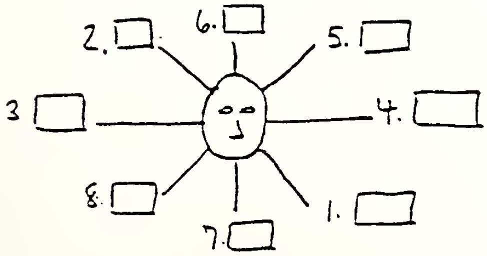
Both Eyes



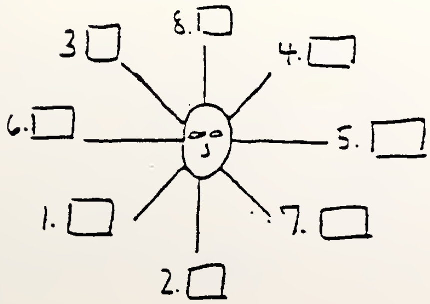
Right Eye



Left Eye



Both Eyes



NAME:______________________ DATE:__________

TRACKING

Setting: Classroom, normal light levels

Materials: 1 small, highly reinforcing object (a food item, cup of juice, highly preferred toy); 1 small, soundless object (penlight in a popbead, mirror, sparkler toy) that is novel to the student; teacher or other familiar person.

Procedures:

Seat yourself across from the student so that your face is directly opposite from the student's face.

Present the object at nose level 12" from the student's face and obtain fixation.

When fixation is obtained, slowly move the object horizontally to the right 6-8 inches. It should take 2-3 seconds to move the object this distance. Observe and record.

If the teacher or other familiar person is the stimulus to be tracked, a second observer is needed. Have the observer seated across from the student at eye level. Stand behind the observer and call the student's name, wave your hand, etc. until the student looks at you. Then walk slowly to the right and out of the student's line of vision. Have the observer note whether the student tracks your movement.

Perform a total of six trials, following the right/left presentation and stimulus list on the following data sheet..

Response:

You are looking for a smooth continuous movement with the eyes remaining in symmetrical alighment with one another. However, several other responses are possible. Only one eye may track for the full distance, or one or both eyes may deviate while tracking. One or both eyes may also only track the object for part of the full distance. Finally, the student may track with his eyes only, with eyes and head simultaneously, or the head may follow the eyes. All of the information about a student's response should be recorded.

Recording the data:

Use the spaces following to record whether the left eye only, the right eye only, or both eyes track (L,R,B). If no tracking is observed, score (-). If both eyes track, note whether the eyes remain symmetrical (+), or if one or both eyes deviate as the student is tracking (-). In the third column, briefly describe the behavior of the student's head while tracking (e.g., eyes only, head follows eyes, etc.) In the fourth column describe any unusual aspects of the tracking behavior (e.g. right eye tracks only the first 1-2 inches, left eye tracks full distance).

STIMULUS	DIRECTION	TRACK (L,R,B)	SYMM	HEAD (describe)	OTHER (describe)
Reinforcer	R				
Novel Item	L				
Person	L				
Novel Item	R				
Person	R				
Reinforcer	L				

Total: L only ____ R only ____ Both ____

Vertical and Diagonal Tracking

Review the data above for horizontal tracking. If you have observed horizontal tracking, use the stimulus items that were most successful to evaluate vertical and diagonal tracking.

Use the same procedures as above, but follow the directions on the data sheet below.

DIRECTION	TRACK	SYMM	HEAD	OTHER
1. vertical overhead ( )				
2. right upper diagonal ( )				
3. left lower diagonal ( )				
4. vertical downward ( )				
5. right lower diagonal ( )				
6. left upper diagonal ( )				

NAME:____________________ DATE:__________________

SHIFT OF GAZE

Setting: Classroom, normal light levels

Materials: 3-4 small (2-4 inches square) visually complex objects such as small hand mirrors bull's eye targets, small kitchen utensils, which are novel to the student. Two to three objects known to be high in reinforcement value to the student. Based upon your familiarity with the student, select items which you think might prompt the student's curiosity. For some students pictures or photos may be appropriate; for others the objects may have to be quite large or of high contrast colors, or lit by a penlight. A 1x2 foot cardboard screen.

Procedures:

The student should be seated at a table or in his/her wheelchair with a lap tray. Seat yourself opposite the student with your face on the same plane, so you can easily observe the student's eyes.

Hold the screen perpendicular to the desk 10-12 inches away from the student. Behind the screen place two of the objects 6 inches apart. Quickly lift the screen and watch the student's eyes for 5 continuous seconds. Repeat 3 times, using different sets of objects on each trial.

Response:

You are watching for a rapid shifting of the eyes back and forth between the objects 3-5 times within the 5 second period. However, the response may be much slower and/or the student may shift gaze only once or twice.

Recording the data:

Score any shift of gaze within the 5 second period as a (+). Also note the number of shifts observed during the 5 second period.

OBJECTS	SHIFTS	# SHIFTS

Total __________

APPENDIX B. MEDICATIONS COMMONLY USED AND THEIR EFFECTS ON VISION.

Introduction.

This section relates the importance of various drug therapies to side effects which in one way or another result in decreased vision. Decreased vision can come about in a variety of ways and usually becomes important when the functional level of vision is even slightly impaired. While the effects, for example, of a mydratic agent used to dilate the pupil of a normal adult for an eye examination may seem as just an inconvenience to some (e.g. cannot drive for a while and need to wear sunglasses even inside), a similar decrease in optimum vision may have serious educational implications to a child - especially the child already with a vision or other sensory deficit. Even simple irritation about the eyes can therefore be a problem that needs to be dealt with to ensure optimal visual efficiency.

Always keep careful records concerning medications and any apparent visual side effects. Teachers are often the first to observe changes in behavior due to medications and usually know about problems before the child's physician is aware of individual side effects.

No attempt is made here to provide an extensive listing of ocular side effects commonly attributed to medications which are often used in children - especially handicapped children. This appendix is intended to impress upon the teacher that the fact that a child <u>is</u> on some medication(s) is important. This could lead to improved visual efficiency simply because the family or physician will be alerted to the side effects you observe. It may then be possible to alter and improve the therapy required.

Drugs to treat infections -

<u>Antibiotics</u> - Most ocular side effects to a variety of antibiotics are related to allergic skin responses (unless the individual already has some skin or blood condition which predisposes them to other adverse side effects). For example, ampicillin and penicillin commonly cause some allergic response which can result in irritation about the eyelids and some conjunctivitis. Ordinarily, these and even more serious problems are temporary and stop when the drug is discontinued.

Most antibiotics can cause a long list of rare side effects. However, tetracyclines, erythromycin and related drugs as well as gentamicin have exceedingly rare side effects of any kind. On the other hand, chloramphenicol has ocular side effects which are common in children (but not in adults) especially with a high total dose or if therapy is extended beyond 6 weeks. Topical neomycin can cause a lot of allergic conjunctival or lid reactions and has considerable

toxicity to the cornea when used about the eye. Sulfonamide antibiotics (sulfa drugs) rarely cause serious side effects though temporary myopia is often seen as are the usual allergenic problems.

Drugs affecting the central nervous system (CNS) -

Antianxiety agents (e.g. Valium = diazepam, Librium, Mebrobamate and Dalmane) are often used in the management of various behavior problems related to anxiety, tension or agitation and are also skeletal muscle relaxants. While significant ocular side effects are rare and reversible, decreased corneal reflex, decreased accomodation and depth perception problems and unusual eye movements are known to occur with normal dosage levels. Diazepam more often than the others causes double vision and nystagmus.

Anticonvulsant drugs (e.g. Dilantin = diphenylhydantoin, Zarontin and Tridione) are effective in the prophylaxis and treatment of chronic epilepsy and Parkinson's disease (Dilantin) and petit mal seizures (Zarontin and Tridione). Many side effects are attributed to Dilantin but nearly all are reversible after the drug is withdrawn. The earliest sign of Dilantin toxicity is nystagmus which is directly related to the blood level of the drug. Sometimes nystagmus persists even after the drug is discontinued. Tridione has the unusual side effect of causing prolonged "dazzle" when the eyes are exposed to light. This results in decreased vision, momentary blindness and a loss of color perception. Ordinarily this effect is absent after the drug is discontinued though it may persist for some weeks.

Antidepressant drugs (e.g. Tofranil, Adapin and Ritalin) are usually used for depression in adults though Ritalin is used extensively in hyperkinetic children. The tricyclic drugs (Trofranil and Adapin) have a variety of reversible, temporary side effects with mydriasis and cycloplegia being most common along with occasional "dry eye" problems. Extrapyrimidal symptoms are seen at times with Togranil (imipramine). Ritalin side effects are rare, reversible and not usually significant, with mydriasis rarely occuring except in overdose situations.

Antipsychotic drugs (e.g. phenothiazine derivatives: Thorazine, Compazine, Mellaril, Trilafon and Stelazine; Navane and Haldol) are widely used for a variety of manifest psychological disorders, with Thorazine (chlorpromazine) the most extensively used of the group. Most of the significant ocular side effects occur from

prolonged use of these drugs over a period of years. The most common problem from the phenothiazines is decreased vision in general, which is probably due to anticholinergic interference. Phenothiazines also may cause pigmentary deposits in or on the eye, as can Navane. Haldol ocular side effects are often transient and reversible when the medication is withdrawn.

Sedatives and hypnotics (e.g. Alcohol; barbituric acid derivatives: Phenobarbital, Secobarbital, Mysoline; and Chloral hydrate) are used - and abused - in a variety of situations as CNS depressants/sedatives and as anticonvulsants. Alcohol and barbituates are each known to cause a long list of ocular side effects, though for each the problems are nearly all associated with habitual use or acute poisoning (overdose). The most common side effects (seen sometimes at therapeutic levels) relate to eye muscle coordination which can result in double vision, convergence problems and nystagmus. Habitual barbituate users exhibit ptosis (lid droop) and blepharoclonus (fluttering of lids as a reflex response). Chloral hydrate at therapeutic doses may cause decreased convergence and miosis and sometimes ptosis. Excessive dosages of chloral hydrate can cause more severe side effects and even a delirium characterized by hallucinations where objects look smaller than their real size.

Analgesics (e.g. aspirin, codeine and Tylenol) have quite rare ocular side effects, and when they occur, at sometimes low doses, imply a drug idiosyncracy or hypersensitivity. Toxic effects of aspirin are more frequent in infants and children than adults. Codeine side effects are also rare, though miosis has been frequently reported and transient myopia known to occur.

Drugs affecting hormone and systemic diseases -

Adrenal corticosteroids (e.g. cortisone, prednisone, hydrocortisone, triamcinolone, etc.) are used for replacement therapy of adrenocortical insufficiency and in treating inflammatory and allergic disorders. Ocular side effects from this class of drugs are common and are often significant and depend on whether the steroids are taken systemically or topically. The toxic effects can be widely varied and are more likely to be dose-related than time-related, though important adverse reactions usually require a number of weeks of therapy to occur. One type of cataract is often associated with systemic steroids and glaucoma can occur with topical administration to the eye. Young children are apparently more susceptible to these problems than

adults. In general, problems can also arise due to the decreased resistance to infection resulting from steroid use.

Drugs primarily used in ophthalmology -

Diamox (acetazolamide - a carbonic anhydrase inhibitor) is effective in treating glaucoma as well as edema and centrencephalic epilepsies. The side effects are usually transient and not important though myopia is the most common ocular complaint.

Miotic drugs (e.g. Pilocarpine) used for glaucoma may, in addition to producing the desired miosis, cause accomodative spasm resulting in decreased vision. Such effects usually do not persist and are rare.

Atropine, used commonly to produce mydriasis and cycloplegia for an eye examination, will produce decreased vision because of these effects for some time, but the main reasons to withdraw use of it results from contact dermatitis. It has been noted that greater pupillary response is seen in people with Down's syndrome.

Miscellaneous medications -

Insulin, used to manage diabetes mellitus, has no direct toxic effect on the eyes. Ocular side effects associated with insulin are probably due to hypoglycemic attacks are usually reversible.

Vitamins (e.g. A and D) can cause ocular side effects especially in infants and young children. These effects can be serious when the dose is very high and the intake not stopped.

Principle reference: Fraunfelder, F.T. Drug-induced ocular side effects and drug interactions. (Philadelphia: Lea & Febiger, 1976)